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JUNE 1967 THE NAVAL AVIATION SAFETY REVIEW

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By LCDR S.B. Sloane, VP-8 ASO

The Second-Tour Plane Commander

Lieutenant Commander Sloane revives an old and at times highly controversial subject . . . the second-tour Plane Commander. The authors' treatment of the narrative and its characters, though fictitious in this article could conceivably exist. It provides good food for thought and discussion.

It should be recognized, however, that the second-tour aviator is now carefully screened prior to reassignment to a fleet operating squadron. The screening process does not stop here but rather continues along with the officer as he is programmed back through the various schools prior to reaching the model replacement training squadron.

The CRAW/CRAG concept, combined with NATOPS, has almost eliminated the type of nonprofessional pilot (first or second-tour) portrayed by "Joe" in this article.

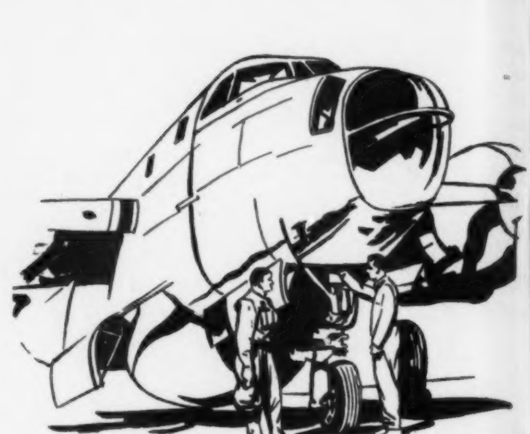
The product of 56 years of naval aviation experience is embodied in both man and machine. The naval aviator of today is a dedicated professional in every sense of the word.

The alarm clock was loud enough to wake the dead. Reaching in the predawn darkness to silence it, I felt almost happy that 0230 had finally rolled around. We had gone three days without flying a mission and the boredom at the deployment base had increased as the end of our tour there drew near. It was to be a day without the annoying details of administration, the vocally expressed gripes of enlisted men, the more subtle gripes of officers, the plodding back and forth between the hangar, the BOQ, the O Club, the movie, the exchange. I was still tired but happy to be able to look forward to something more absorbing than pure administrative routine.

Riding to the flight line in the rickety old duty truck I sat silently anticipating sunrise and listening to a conversation between my Plane Commander, LCDR Joe Secondtour, and the PPC of the aircraft that was to act as our backup for the morning ASW Patrol. It was a conversation that held the key to Joe's personality, the events to come and perhaps to an important element of aviation safety. Joe spoke first.

"Listen old buddy, you really don't have to sweat this backup business. Our crew never aborts a mission."

Was Joe's hand shaking or was it the vibration of the throttles?



"You could save me some preflight type of work if you would guarantee that."

"Just for the sake of making the CO happy you had better go through the motions of standing by in case we can't make it. But don't you sweat it."

The drone of Joe's bragging about our crew and his ability faded into the background. After four months of listening to him I had developed a defensive immunity. As a fairly senior LCDR he had taken over the crew shortly after he checked into the squadron. It had become obvious to most of us who flew with him that his lack of recent experience and his marginal capabilities to handle an inflight emergency were only exceeded by an understandable, though annoying, desire to build an image that was a combination of the Flying Tigers and the Blue Angels. With the inherent reliability of a four-engine aircraft and an experienced crew behind him, Joe's desire to create such an image was, in fact, one which he was unable to live up to; but, it had been reinforced by a lack of problems thus far. I guess Lady Luck (does any aviator doubt her existence?) had been on Joe's side. But Lady Luck, it seems was sleeping in that morning.

Preflight and briefing were routine and I was happy to see them over with. The voice of the tower operator penetrated the bang of our recips and the whine of the two jets and cleared us for takeoff. As Joe confidently eased the throttles forward I glanced from his devil-may-care facial expression to the two long rows of yellowish white lights and the ink-black sky that would shortly engulf us. He released the brakes. As I felt the pressure of acceleration on the small of my back I placed my left hand gently over his right hand to back him up on the throttles. His gloved hand was wet with perspiration although a predawn chill filled the cockpit. Was his hand shaking or was it the vibration of the throttles? As we accelerated during the first few seconds of takeoff roll, I reminded myself that a heads-up copilot's duties do not normally include observation of the PPC's facial makeup, or sweat on his hands. I settled down to focus my strained eyes on the round red dials that glowed with the unalterable truth of the bird's immediate performance.

The number two engine manifold pressure began to fluctuate abnormally as soon as our airspeed provided enough ram pressure for full power. I announced this fact to Joe but did not look up at him, preferring to concentrate on cross-checking the gages instead of observing his reaction. The spastic bounce of the power gage was echoed by loud backfiring. I glanced at the airspeed indicator; it read 80 kts. I didn't have to look at the runway to realize that we would have more than enough concrete remaining to excute an uneventful abort. I needed neither handbook, nor outside air temperature, nor the instinct of a World War II three-time ace to make this calculation.

"The right engine is backfiring and apparently losing power. You are not yet committed. Recommend abort!"

As the dynamic pressure on my frame transferred itself from my back to the seat of my pants I knew that we were airborne and going up. Not being one to fully trust sensory perception I cross-checked the gages and indeed, we were airborne and becoming more so every moment.

"Gear UP."

"Throttle back to normal rated and dump the jets. That's good. The right engine has stopped complaining now that I've taken some of the MAP off."

"Turn to a heading of one two zero for the operating area and level off at fifteen hundred feet. Good show, Joe!"

This was not the proper time at all for me to

critique Joe's takeoff technique and abort procedures. I merely stated that the starboard recip had demonstrated traits somewhat less efficient than those of a smoothly running Swiss watch.

I settled down to the cockpit routine by leisurely going through the Cruise Checklist while Joe trimmed her up in anticipation of punching in the autopilot. As I gently eased the starboard mixture control handle out of the FULL RICH slot—"ker blam, ker blam . . ." "There she goes again," I thought. The mixture handle found itself back in the RICH slot about halfway through the first "blam" and the second "ker."

"She won't run at all out of the RICH slot, Joe. The heading back to the field is three zero zero, range about 20 miles. I'll contact the tower."

"Just a minute. She runs in RICH okay?"

"Yes."

"Let it run in RICH."

With a 13 hour hop ahead of us I felt certain that running one engine in RICH would cause our aircraft to run out of fuel in considerably less time than it would take to fly the mission. Not wanting to stake my professional reputation or my prospects for impromptu retirement on a guess computation, I broke out the book and the E6B in order to have the right kind of evidence to present to Joe. Joe was by this time obviously not going to abort the mission. I never had a chance to open the book. Somewhere between me and the right wingtip all hell broke loose. That somewhere was localized within the confines of the starboard engine nacelle.

Joe, his attention now devoted elsewhere, was rapidly losing both altitude and the devil-may-care smirk. In the moonlight I could see that the Flying Tiger image had melted. Without really thinking about the details involved I found myself going through the engine-secure procedure that I had practiced at least a thousand times. Throttle—CLOSED: mixture—IDLE CUT OFF; engine—FEATHERED (that's it THE RIGHT ONE); mag—OFF; fuel shut off valve; light off the jets. In a very few seconds the sick engine had been put at parade rest and was out of its misery. Glancing down at the attitude gyro I could see that the loss of power on one side had not been compensated for with trim or the flight controls. We were in a 45-degree bank to the right. Joe's mind must have been lagging behind the situation.

"Feather number one," he said.

"I've already feathered number two. Level your wings."

As I saw the little wing on the little airplane on

the little gyro instrument drop further below the horizon I yelled, "I've got the airplane."

Wings level . . . full power on the three remaining engines . . . eeease the nose up. Airspeed: 120—121—122—125—130—140—155. Altitude: 100—120—200—500—1000 . . . "We're going to make it."

The above narrated incident, while certainly not typical, does stimulate some thought in the area of typical problems. Joe's specific problem was that he was not mentally prepared for this emergency. The general problem area brought to mind is that in many respects squadrons do very little to help the man in charge of each crew—the Plane Commander—maintain an acceptable level of this aspect of proficiency. Let us first examine the plus side of the ledger and see what inherent advantages the second-tour pilot has. First of all he is an experienced naval aviator with thousands of hours of pilot time. This flight time may not be in current type or model but it should enable him to approach the wild blue yonder with a seasoned, mature, professional attitude. His time in service and his rank indicate that he has the ability to command a crew and to understand all the tactical and strategic implications of *the big picture*. He has been provided with CRAG training and is required to demonstrate an acceptable level of competence on his initial PPC check and on annual instrument and NATOPS check flights. The fact that he has reached this advanced state in life indicates that he has successfully survived the many obstacles that both the system and the fates have

Problems occur when, in an emergency, the pilot reverts to a habit pattern not applicable to the situation.

placed in his path since preflight days.

With all these inherent advantages a squadron should be able to welcome this intrepid, steely-eyed, master of the skies aboard, place him in charge of a crew and trust that his father image will make everything turn out "A-OK." This would be true if not for certain inherent disadvantages. No one individual is unfortunate enough to be plagued by all of these, but most will be affected in some way.

Many second-tour pilots have accumulated habit patterns which result from experience in aircraft other than the model being currently flown. In transitioning from aircraft powered by reciprocating engines to turbos, from small training types to heavy multi-engine types, from mechanical flight controls to power assisted flight controls, from low altitude, low speed to high altitude, high speed, etc., many previous ideas, procedures and habits must be replaced and updated. In many cases this learning process is a difficult one. This can become serious when, in an emergency, the pilot reverts to a habit pattern which is not necessarily applicable to the current situation. Experience, therefore, is not *all* gravy. Furthermore, the recent experience of second-tour pilots is in many cases limited to three or four years of driving around the sky in a proficiency status. As post-graduate school tours become more readily available to "first short tour" officers, less and less mental energy is devoted to developing as a professional airman. Each year, a larger percentage of lieutenant commanders or lieutenants who have been primarily concerned for a number of years with book learning report to squadrons. These people are initially far less proficient than they were at the end of their first sea tour.

The average second-tour pilot has a lion's share of administrative responsibility. As a department head, assistant department head or other supervisor, his time and energy are spent on the various administrative problems that must be solved in order to keep the squadron going. Often he has neither the time nor the inclination to participate in frequent training flights, study the NATOPS manual, or partake of the pearls of wisdom that are part of the everyday wardroom bull sessions. Additionally, the complexity of family life may be such that many off-duty hours are devoted to the PTA, Boy Scouts, the Little League, the real estate broker, the investment broker, the insurance broker, etc. Gone are the carefree days of the happy hour debrief and relaxing hours of hangar flying around the living room. The CO expects him to be a brilliant administrator, his children expect him to a devoted father and his wife expects him to be the duty driver, carpenter, electrician, disbursing clerk, mechanic, social director and "please don't talk about flying at the bridge game tonight." In general, it becomes more and more difficult for him to perform the role of professional aviator.

The result of this complex situation must be a prudent balance between those factors which make him capable of handling any and every airborne situation successfully and those factors which hinder his approach to professional perfection. The problem seems to be that this official view of the second-tour pilot and the modus operandi which results from this view avoid the reality of the situation because

they ignore his inherent weaknesses. In doing so, *the system* fails to assist the man to perform in the required manner.

Evidence of this failure can be found primarily in the very nature of the squadron's flight training program. All efforts are pointed towards training the pilots who have not been designated as Plane Commanders. The second-tour pilot plays the role of instructor and in the majority of cases does an excellent job. As an instructor he is encouraged to keep current concerning emergency procedures. However, the process of fabricating emergencies for the less experienced pilot and observing his performance is somewhat different than handling an actual inflight problem. In simulated emergencies, the solution is conceived prior to the execution of the emergency. This is of necessity since the instructor must know what to expect of the trainee before he gives him the problem. From the vantage point of the instructor the thought process is: "What emergency shall I simulate? What is the proper response? How and when shall I simulate the emergency?" This results in fairly realistic training for the junior pilot but does not appreciably aid the instructor in refining his personal capabilities to handle actual emergencies.

The scheduling of a second-tour pilot to play the role of student is practically nonexistent. The only practice emergency that he handles is usually of the self-imposed variety. This type of practice has two disadvantages. The first of these is the fact that most Plane Commanders will not frequently impose simulated emergency conditions on themselves. The reasons for this are many and varied, ranging from the natural laziness of the human mind to preoccupation with normal inflight duties. At any rate, very few will rock the boat frequently with a simulated engine-out landing or a no-gyro instrument approach, for example. Secondly, self-generated simulated emergencies are not well calculated to mentally prepare the pilot for actual emergencies. This evolution has the same weakness as the instructor-generated emergency in that the pilot himself chooses the time, the place and the emergency.

Theoretically the system of annual NATOPS and instrument check flights helps the situation. In actual practice it helps very little. The studying accomplished prior to these check flights and the emergency procedure practice obtained during the flights is good, but it fails to have any significant, long range effect. In addition, check rides frequently fail to put the pilot through his paces. This phenomenon has been a problem in aviation ever since Orville declared Wilbur safe for solo. No doubt the

advent of NATOPS and the CRAG systems have greatly improved this situation. But no system can change the basic characteristics of human nature which cause this problem. There is a fraternal feeling among designated pilots which is even stronger when the pilots are squadron-mates, and still stronger among the rank-equals of a given squadron.

Before suggesting some solutions, it would be best to restate the problem in light of the above analysis. Second-tour pilots are selected to command crews. This selection is based upon general suitability for the job. General suitability can be mistakenly interpreted to mean infallibility when potential weaknesses are ignored. Because these are often ignored, the environment that a second-tour pilot operates in is one which may be poorly suited to prepare him to react favorably in emergency situations. The weakness of the typical squadron training program is that it does not include as one of the primary objectives the continuous training of second-tour plane commanders.

The solution to the problem consists of a series of steps which, taken as a whole, represent a minor reorientation of the squadron training program and a major reorientation of basic philosophy. First of all, second-tour pilots should be scheduled to fly together on local training flights. The frequency of these refresher training flights will necessarily depend on operational commitments and the training commitments which result from requirements of first-tour pilots. A minimum of one flight per week would be a realistic target. The conduct of these flights should be predetermined by a carefully constructed syllabus designed with the needs of the second-tour pilot in mind. The accent here should be on realistic simulation of emergencies. These flights should be supplemented with periods in the Operational Flight Trainer where those emergencies that are impractical to practice in the air can be reviewed. This more

The Standardization Board can make valuable contributions if it actually functions rather than theoretically exists.

formal aspect of periodic refresher training should be supplemented with imaginative attempts to encourage all pilots to take advantage of available opportunities to practice emergencies. One example of such an informal program would be the publication in the flight schedule each Monday of an "Emergency of the Week." The current emergency could be reviewed at an all pilots meeting and each pilot would take it upon himself to practice this emergency sometime during the week as conditions permit.

The Standardization Board can make valuable contributions in this area if it actually functions rather than theoretically exists. The members of the board should meet frequently in order to discuss individual pilot performance methods of administering check flights. Periodic surprise check flights would certainly encourage all pilots to maintain their knowledge of aircraft systems and emergency procedures at a highly proficient level. If the Fleet NATOPS Evaluator can administer surprise check flights to crews, members of the Squadron Standardization Board should be able to do likewise.

Each second-tour Plane Commander spends a great percentage of his hours in the air involved in operational or operational/training flights. Many of these hours are of the straight and level variety, to and from the operating area. Frequently, first-tour pilots will receive training in the form of questions or simulated emergencies during these hours. A valuable supplement to the above stated elements of a training program for second-tour pilots would be a periodic turnabout in this respect. Fully qualified first-tour copilots are perfectly capable of asking intelligent questions concerning aircraft systems and emergency procedures. They are similarly capable of generating simulated emergencies under controlled conditions.

The informal controls here should depend on a working arrangement between pilot and copilot. The Plane Commander could declare that he is in a training status for two or three hours. During this period of time the copilot would be permitted to ask questions and simulate various emergencies. It is realistic to expect that the copilot would exercise good judgment and refrain from such hairy evolutions as securing the entire electrical system during night IFR conditions.

Of course this sort of activity implies a somewhat unique twist of the junior-senior relationship. But this twist in itself is nothing new. Each second-tour pilot receives to some extent training from his junior prior to the time he is designated as Plane Commander. What is required is for all to admit that the need for training extends beyond designation date.

The most important benefit to be derived from such a reorientation of the squadron's second-tour Plane Commanders is that it is bound to discourage the I've-got-it-made philosophy and encourage the throught among second-tour pilots that they have to toe the mark.

Some will resent all of the above suggestions and implications. Such resentment will no doubt be most prevalent among second-tour pilots. A high level of resentment would demonstrate a high degree of need to alter attitudes which can result in an accident.

Basic Attitude

The potential danger of jet wash and wing tip vortices as described herein is minor compared to the cause of the pilot's difficulty.

The crews of a scheduled three plane F-4B division were briefed for an ordnance hop, and the takeoff set for 1400. The first two aircraft made normal, uneventful takeoffs. At 1407 our pilot released his brakes and added power.

The takeoff run was normal until immediately after the aircraft became airborne. As the gear broke the deck the pilot encountered jet wash, so he initiated a turn to the right to get clear. At full afterburner power, gear down, the starboard wing began to drop. The pilot countered with opposite aileron. The wing continued to drop and full left stick seemed to have no effect.

At 100′ and 120 kts, in a 30-degree bank with the nose 45 degrees above the horizon, the pilot assumed that the aircraft had become uncontrollable and ordered the RIO to eject.

Immediately after the RIO ejected the pilot was able to level his wings, gain airspeed and continue to climb. Slow flight tests subsequently showed no control difficulties and a safe landing was effected.

Severe injury to the RIO and a near accident had occurred because the fundamentals of flight were momentarily forgotten or disregarded. When he encountered the jet wash at liftoff the pilot tried to avoid it instead of continuing straight ahead in an effort to attain maneuvering speed. Acceleration was further hampered by the pilot's failure or inability to; 1) reduce the angle of attack and, 2) raise the gear. By turning out of the jet wash he had increased lift required at a most critical and inopportune time.

His CO concluded that: "In view of the apparent disregard of aeronautical fundamentals by the pilot, the primary cause factor is considered to be *complacency*."

Short  Snorts

Some people are weather-wise, but most are otherwise.

Benjamin Franklin

A Crusader's Crusade

The pilot of an F-8D entered the landing pattern and reported an unsafe nose gear indication. During three passes over the ship for visual checks neither Pri-Fly nor the LSO could detect any trouble so the pilot was informed that the nose wheel *appeared* to be DOWN and locked.

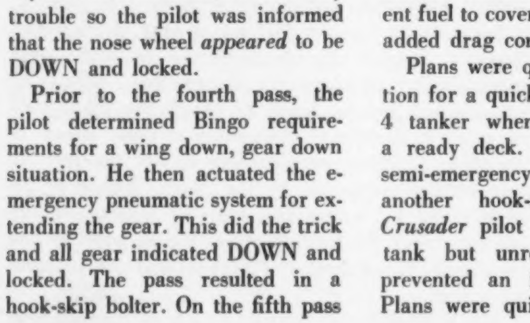
Prior to the fourth pass, the pilot determined Bingo requirements for a wing down, gear down situation. He then actuated the emergency pneumatic system for extending the gear. This did the trick and all gear indicated DOWN and locked. The pass resulted in a hook-skip bolter. On the fifth pass the pilot called Bingo plus one, but was given a fouled deck waveoff. The pilot informed Pri-Fly of his inability to reach the beach because he had blown his wheels down and, therefore, they could not be retracted. He had insufficient fuel to cover the distance in the added drag condition.

Plans were quickly put into action for a quick drink from an A-4 tanker when Pri-Fly declared a ready deck. Unfortunately, the semi-emergency sixth pass was another hook-skip bolter. The *Crusader* pilot made an effort to tank but unreported difficulties prevented an immediate plug-in. Plans were quickly altered for a barricade recovery. The pilot was brought in to a verbal cut by the LSO and was successful in snagging the number 2 crossdeck pendant. As planned, the barricade was also engaged and minor damage occurred. Upon engine shutdown, only 350 pounds of fuel was still aboard.

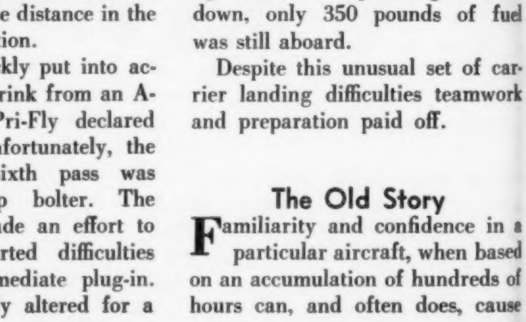
Despite this unusual set of carrier landing difficulties teamwork and preparation paid off.

The Old Story

Familiarity and confidence in a particular aircraft, when based on an accumulation of hundreds of hours can, and often does, cause



The pilot flew his seventh pass to a verbal cut by the LSO.



F-8 wingtip damage following barricade engagement.

pilots to let down their guards. The copilot in the following incident was an old hand in the SNB, who nearly closed out the collection of over 800 hours in type that he had accumulated over the years.

While preparing for a simulated instrument approach on a proficiency flight, the experienced copilot switched the fuel tank selector to the tank he thought held the most fuel. *But he didn't check it.* The less experienced, but equally unwary pilot, meanwhile, checked the fuel quantity indicator without looking to see which tank was selected.

The copilot thought he had selected the port main fuel tank, when in reality the fuel selector was 180 degrees away on the starboard auxiliary tank. The fuel quantity gage was set on the port main, which indicated about eight-tenths full. As the pilot began his approach, the auxiliary tank which was actually supplying fuel to the engines held only one-tenth of a tank.

On final approach the starboard auxiliary tank ran dry, and both engines suddenly quit. The copilot immediately selected another source of fuel, while the pilot tried to salvage things with a glider approach. The aircraft clipped the tops of several trees, but the engines caught in time to prevent it from touching down short of the runway. A flap change resulted from the holes punched in both flaps by the trees.

Nose Gear Failure

A student pilot was engaged in field carrier landing practice (FCLP) in a T-2A. On his 9th pass, the aircraft touched down in an abnormally nose-low attitude and the nose wheel hit the runway with enough force to break the nose gear down lock assembly.

Fortunately the trailing nose gear absorbed the skidding.

Since he added power almost immediately the student was airborne again before his nose gear could collapse.

The LSO only became aware of the trailing nose gear when it was sighted from the ground. He instructed the pilot to make a low pass close aboard for inspection. The strut seemed to be trailing about 30 degrees aft and the wheel was cocked several degrees off to the side. It would not move with wheel retraction or extension.

The decision was made to attempt a nose high landing. Accordingly, the LSO talked the pilot down to a touchdown slightly faster than normal in order to keep the nose wheel off the runway as long as possible. Angle of attack was at 13/14 units. When elevator control could no longer hold the nose wheel off, the aircraft's speed was slow enough to minimize the force as it pitched forward. The fuselage was not damaged because the nose gear took all the skidding.

Runaway Prop

A C-54Q was cruising along at 10,000′ when the oil quantity gage on number 4 engine was noted to drop abnormally. A visual check revealed excessive oil on the cowl. The oil temperature on the engine began to rise and when it reached maximum, the propeller was feathered. The engine decelerated normally down to an estimated 20 rpm then slowly increased as the prop failed to go into the FULL FEATHER position. Subsequent efforts to refeather the propeller failed. The RPM increased to 2500 in low pitch and it became apparent that it was stuck in this runaway condition. The drag increased to such a degree that level flight could only be maintained with the other three engines running at full throttle.

It was quickly estimated that the other three engines would fail before the nearest operational airport could be reached.

The best airspeed for minimum descent and acceptable control was 110 kts. The terrain was mountainous desert and a landing was imminent. The only airport available was a 4300′ dirt emergency strip. Two left-handed approaches were abandoned due to excessive settling in a 10-degree bank. The two waveoffs caused the three good engines to exceed their CHT limits. A third approach utilizing a right hand pattern got the airplane safely on the deck.

Subsequent investigation of the number 4 engine revealed excessive metal contamination. The other three engines also indicated metal contamination due to the extended periods of maximum power and overheating. All four engines had to be changed before the airplane could be returned to normal operations.

Ed. Note: Additional details on the prop malfunction were not available. It does appear that the crew had an appropriate combination of skill and luck on hand that day.

Some Discussion and Recommended Techniques for Landing on . . .

Wet Asphalt Runways

By Captain M. F. Stone, USMC
ASO, MAG-11

The only way to land an aircraft is on speed. There is no advantage in touching down faster than optimum, or slower, for that matter. Be aware of the fact, however, that a 1 percent increase in speed above optimum will increase rollout distance by 2 percent.

Land in the Center of the Runway

If you touch down anywhere *but* in the center of the runway, a force vector to the side of the runway is automatically present. This is due, of course, to the high crown of the runway, and is aided by the slickness of the wet asphalt. This feat is relatively easy to rectify in the daylight, but at night it's another story. I recommend that *all aircraft* land with taxi lights ON, repeat ON. Someone told me that was "cheating." That's right! You are cheating the Grim Reaper, and should be proud of it! The taxi light may not help you locate the centerline until touchdown, particularly in the F-4, but once you touch down you will know your line-up status immediately. In the case of no taxi light or its ineffectiveness, the pilot is going to have to rely on his perspective in relation to the runway lights, in order to touch down in the middle of the runway. If the touchdown is off center —don't panic. *Ease* the corrective controls in and

nurse the bird to the centerline. One last point here —insure enough separation in the landing pattern for each aircraft to take the middle of the runway.

Land Going Straight Down the Runway

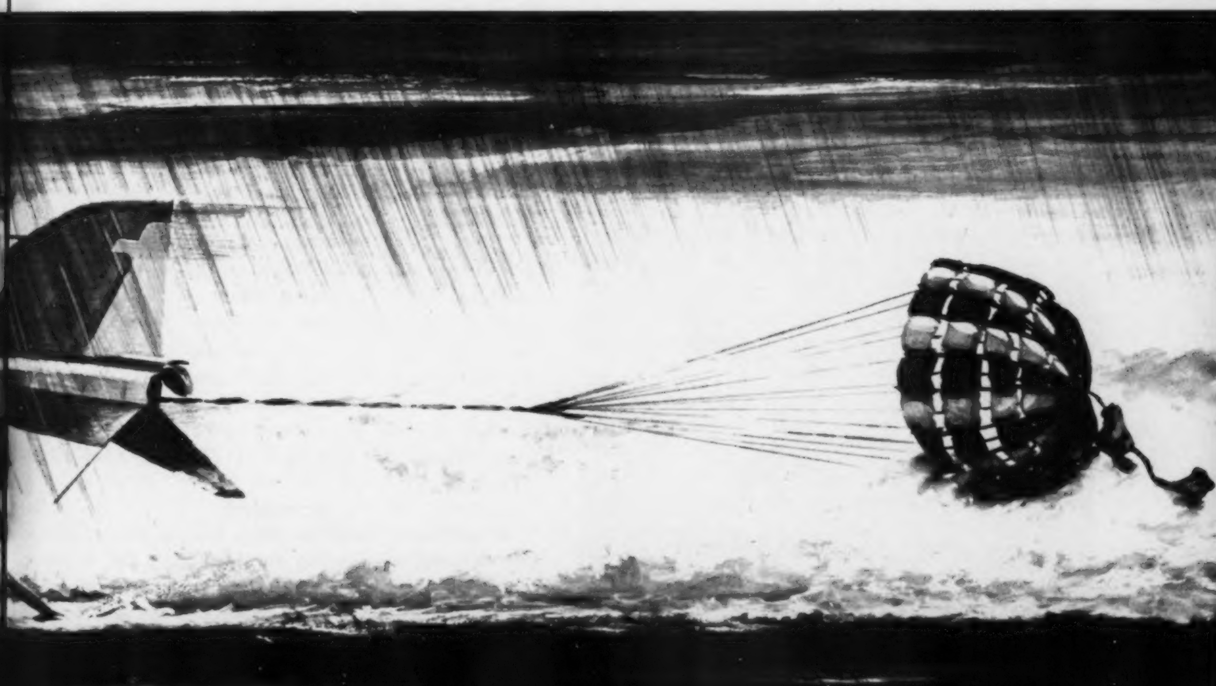
If you land in a skid, you have problems already. Not wishing to get into an argument on crosswind landing techniques I nevertheless advocate the wing down/top rudder type crosswind correction, when on short final. It keeps the aircraft pointed straight down the runway all the way from short final to touchdown with no corrections to make prior to touchdown. But whatever your method of getting to touchdown, especially in a crosswind situation, make the contact with the aircraft pointing and going straight down the runway. *Don't land in a skid.*

Using the Drag Chute

Under normal conditions, e.g. calm or down-the-runway winds, the drag chute should always be deployed—even if a morest cable stop is planned. Delay deployment until 1000-1500′ before the morest. You will have just that much more going for you. If the morest engagement is successful, no damage or ill-effects will occur to the chute or aircraft. If you miss the wires you are ahead of the game. Chute deployment in a crosswind is another matter. If the morest units are up and there is any crosswind at all, forget the chute and bank on the morest. The point is, of course, the "blossom behind" will weathercock the aircraft in a crosswind and set you up for a bad situation. So play it accordingly.

But whether you have a drag chute or not, in an F-4, A-4, A-6, F-8, or F-9, the insidious nature of a wet asphalt runway after touchdown is a problem because of the runway's relatively smooth texture, its composition, and the high crown. Lengthy and quite technical presentations are available on hydroplaning and coefficients of friction as opposed to tire pressure, tire footprint, etc. These factors have been and will be inherent in our problem.

An aircraft on a wet runway is almost like a free floating body. Any aircraft is highly responsive to control movements, especially during the initial phase of rollout, and will even react to asymmetrical aerodynamic forces or loading (hung bombs, rocket pods, and so forth). Granted these may be small factors but they do exist on a wet surface especially at the higher speeds immediately after touchdown. The F-4 seems to possess almost neutral stability in the horizontal plane (about the yaw axis) below fuel



weights of 4000 lbs. I feel this accounts for the frequent fishtailing of the F-4's down to speeds of 90-100 kts. Any and all *corrections* or *control movements* must be *smooth* and *gentle*.

Slipping and Sliding

A skid, slip or slide, or whatever you call it, is occurring when the path or movement of the aircraft is different from the direction in which the aircraft is pointed. When this is occurring, the aircraft wheels are not turning effectively, and the rotation of the wheels must be in the same direction as the path of the aircraft to get any effective deceleration. Maximum braking or deceleration cannot be obtained unless the wheels are (a) *rolling* and (b) rolling in the *same direction* as the path of the aircraft. Therefore the initial correction for any skid is to turn the aircraft *axis into the skid*. The best illustration is a skid where the aircraft is sliding straight down the runway with the axis of the aircraft at an angle to the centerline (could be caused by touching down in a skid). The obvious correction is to ease in appropriate rudder (and/or aileron/spoiler) to turn the axis of the aircraft down the centerline—and that correction is a *turn into the skid direction*. In any other skid condition, especially where the path of momentum is to the side of the runway, turning into the skid is completely adverse to human response. *But that must be the initial correction*. Once the aircraft is pointing to where it is moving, the pilot has control again and can continue to ease the machine back to the centerline.

The Waveoff

Another action always available to a pilot when things aren't going too well—*wave off and take it around*. But this action has some points of interest

Arrested landings on wet runways can be routine.

also, especially if the hook is already down. You can see the problem becomes more acute as the waveoff is elected closer to the morest wires. It is simple enough to raise the hook. Just make sure it is done in time to preclude an inflight engagement on waveoff. This also leads to the thought that each pilot must know exactly where each arresting cable is and how much remaining runway he has for rollout, waveoff, or stopping.

Braking

There is only one way to brake an aircraft, wet surface or dry—even, steady, continuous application of brakes. The experts instruct that braking to that point just before a skid, is optimum. But the pilot has no positive indication of where that skid point is until his wheels actually start skidding. Therefore, he can apply brakes evenly and steadily, and as long as he is obtaining deceleration of the aircraft and not skidding, braking is effective. If it is pushed into a skid, ease up until the wheels are rolling and reapply—steadily and evenly. The speed to start braking action varies with model aircraft, but generally, on a wet surface braking is not going to be too effective until below approximately 90 kts in any aircraft.

Nose Gear Steering

Nose gear steering is not much aid to you until you are below 80-90 kts. The control from nose gear steering you think you are getting at higher speeds is actually due more to the rudder deflection. And that rudder deflection *with* nose gear steering actuated will more than likely set up conditions more conducive to overcorrections.

Arresting Gears

Each pilot should know the status of the arresting units on each runway. This should be passed out at the *briefing prior to each hop*. Upon arriving at the field for landing, the pilot should double check the status of the arresting gear and know what he has available before he starts down.

Don't hesitate to use the BAK-12 gear—but be aware that the tower will close the runway to re-rig the gear which will take 10-15 minutes.

After a successful arrested landing don't be too anxious to build up a lot of speed to clear the runway. An aircraft will skid at 10 kts as well as at 110 kts.

Summary

In summary; land on speed, land in the middle of the runway, land going straight down the runway, and be gentle and smooth on the controls. A pilot has to *fly* his aircraft all the way to the chocks during wet weather operations. Be aware of the conditions, the alternatives available, the characteristics of the aircraft, and stay on top of them all.

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NOISE

Vietnam, thanks to our efforts to contain "Charlie" (and vice versa), is a very noisy place. In the air there are the sounds produced by the engine, the sound of the rotor or prop, the slipstream noise, not to mention the very distinctive sound of rounds being fired—outgoing *and* incoming. Back on the ground there are "beaucoup" noisy generators and a roommate who insists the *only* way to listen to his tape deck is with the volume turned all the way up. (That way, he says, the artillery firing does not interfere with his listening pleasure.)

The problem is really twofold. It is essential to hear the radio transmissions clearly *and* to protect your ears from the hearing impairment which results from acoustic trauma.

Sound which is excessively loud will tire the ear and make it less sensitive. Ordinarily this loss of hearing is temporary. The duration of the loss depends on how much noise the ear has to stand, what kind of noise goes on and the durability of the ear itself. In many individuals repeated exposure to fatiguing noise causes permanent impairment of hearing.

These hearing losses begin in the frequency range above that needed for hearing normal speech. The significant feature of this high frequency loss is that, if the exposure to fatiguing noise continues, eventually the speech frequencies become involved.

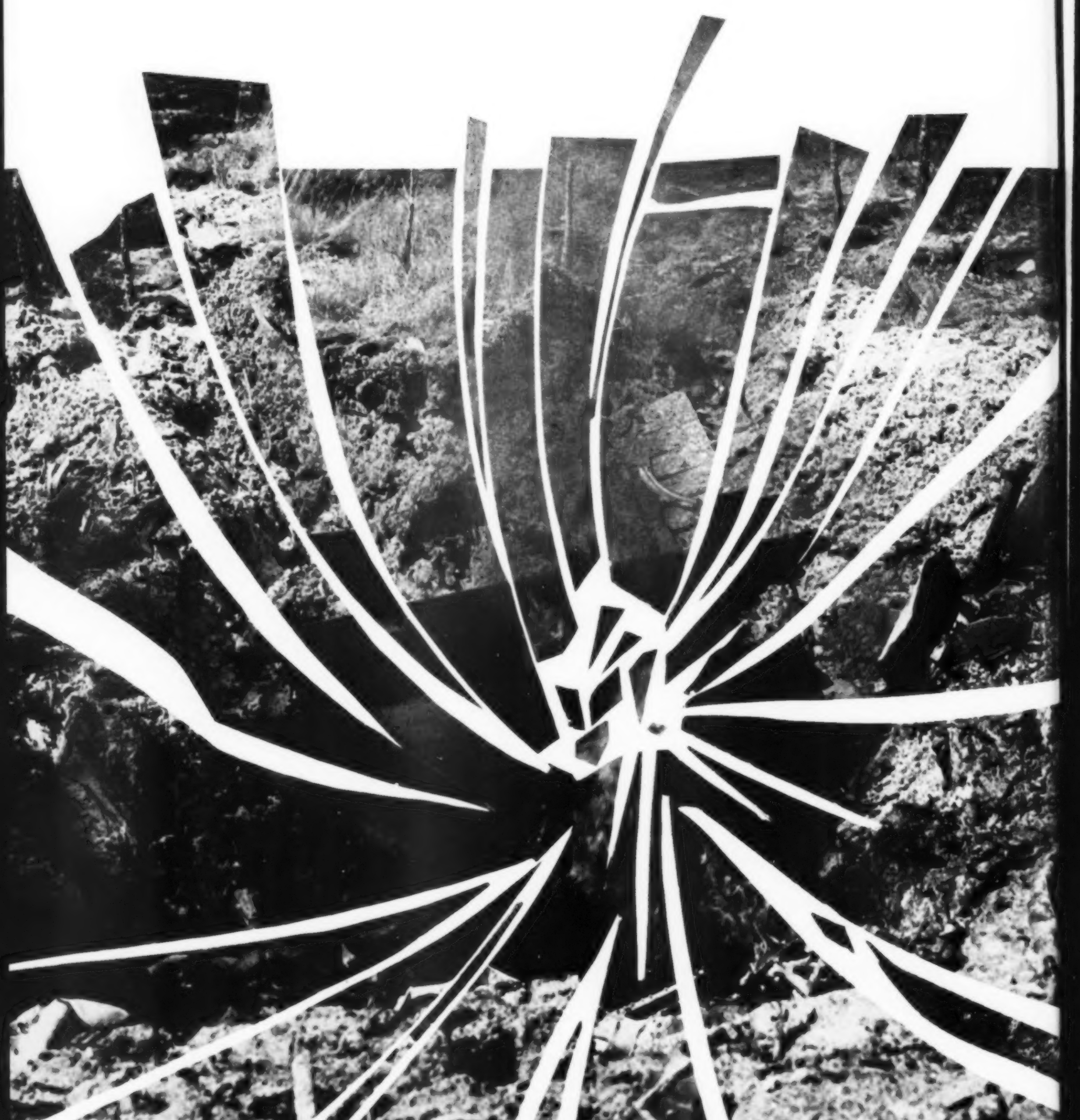
We have established that there are excessive noise levels in the aviation environment. The first part of our problem is to hear the radio clearly. When you try to listen to sounds of similar pitch but different loudness, the louder sound blots out or masks the quieter one. In other words, there is competition between the radio transmissions you are trying to hear and all the other sources of noise in the aircraft, i.e., the engine, slipstream, etc.

The solution to both the problem of hearing the radio and protecting your ears from permanent damage is to wear earplugs and a well-fitted helmet all the time when you fly. The combination of flight helmet and earplugs reduces the loudness of the noise by about 50 decibels, well below the levels of hazardous noise exposure. You will find, surprisingly, that you can hear radio transmissions more clearly while wearing earplugs. This occurs because the earplugs reduce the outside noise which tends to mask the radio transmissions. Thus, there is a better ratio of speech to noise than is possible without earplugs, and speech signals now tend to mask the noise rather than vice versa.

So get your friendly flight surgeon to fit you with a pair of earplugs and use them. You will hear better —and longer.

—USARVN Aviation Pamphlet

INVESTIGATION



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PROCEDURES

By J.A. Margwarth

Manager, Flight Safety Division, Lockheed-California Co.

Mr. John A. Margwarth is Manager, Flight Safety, of the Lockheed-California Company, a division of Lockheed Aircraft Corporation. The material contained in this reprint of his article, "Investigation Procedures" is applicable to any aircraft accident investigation, whether it be civil or military. The techniques described in his various examples may well contain an idea which someday could aid an aircraft accident board in determining the cause factors of an accident having similar characteristics. There is no substitute for experience and the investigation procedures discussed herein are the result of experiences that Mr. Margwarth has gained in this field.

Some weeks ago two officers, each intimately concerned with flight safety, asked me for my ideas about accident investigation procedures. One specific question was directed at how much I used the various "handbooks for investigators" that are currently available. The answer to that question developed into a story telling session which culminated in their request that I "put some of it in writing." Hence, the following article.

I think the investigator's handbooks are fine tools, and desirable guides, especially for those who have not had years of investigation experience. I have found, however, that these documents are not by themselves always enough and that careful thinking and extreme curiosity and imagination frequently are important additional factors leading to the determination of true cause.

Generally speaking, careful thinking is usually thought of as being slow or time consuming. However, careful thinking must sometimes be rapid. Careful thinking should start immediately after the accident to determine, first of all, if you should take a rapid or slow route. The right decision here can lead to success instead of failure. For example, we had a specially instrumented, twin-engine test aircraft fail to recover from a high-mach dive. Remembering that the aircraft was specially instrumented prompted a decision to immediately man-sweep the wreckage area for the undeveloped film records before the sunlight ruined the film, in case the film magazines were broken.

Sure enough, the records were found, although one would hardly recognize that the broken and mutilated remains were once film in film magazines —and sunlight had been beating on the torn and loosened film already. Once the film remains were stowed in black boxes in a dark room the investigation process was intentionally changed to a slow pace. Days were spent in consultations with the best film developing experts in the country as to how to develop the already exposed records with maximum chance of success. Success finally was achieved and the results led directly to valuable information on some high-mach aerodynamic characteristics and the need for changes to the aircraft's longitudinal control system.

As another example of the occasional need for rapid action, I know of more than one case where ice caused an accident or an incident, such as ice in the fuel system, the airspeed system, or the aircraft control system. If your initial information coupled with your imagination does not cause you to think of these possibilities, it's a matter of time until the ice melts, and the water subsequently drains away or evaporates (unless the water is trapped). Then your direct evidence is gone.

I remember a case of simultaneous loss of engine thrust on a prototype twin-engine jet, with the result that the aircraft had to be landed in a field (not to be confused with an airport). The fact that ample fuel was aboard the aircraft, yet both jets lost power at

the same time, made fuel system icing a suspect item. Therefore, fuel samples were taken immediately from strategic points, and various fuel line sections were capped to trap all fluid before the aircraft was disassembled and moved to a building for further investigation. This capture of fuel and water by location led to a most interesting and time consuming solution of the accident cause, even though the content of dissolved water in the fuel was within normal limits each time the aircraft was fueled. Laboratory tests confirmed fuel system icing as the cause of the accident.

On the matter of moving too fast, I have a strong emotional feeling about those early bird characters who arrive at the wreckage scene and turn parts upside down, move parts, move the wing flap control handle, move the fuel shut-off valve switch, rotate the radio frequency selector, and pull one or more circuit breakers. Some of these individuals have in one second set an investigation back a month, or forever. Actually, this is not so much a matter of moving too fast as it is ignorance and/or lack of security and investigation controls.

Now that I've mentioned fuel shut-off valves, if you want a real puzzler take a circuit malfunction that runs the valve closed, then back to the open position prior to aircraft impact. This is a situation wherein you must have the imagination to think, "Could this happen?" Then you work on that challenge and finally show that, under certain conditions, it could happen —or it could not. The point is, if you don't "worry and fret" and ask yourself these hypothetical questions, you will miss arriving at the probable cause

Putting the pieces back together takes time, effort and sometimes a great deal of imagination.

Witness information can be good or bad but it always pays to consider it carefully.

factors for certain accidents.

A casual, less-than-careful evaluation of certain available evidence can easily throw you off completely in certain accidents. I recall a downward ejection from one of our test birds at 15,000′. Observation of the ground location of the bottom hatch, seat and pilot-landing-point were all about as to be expected. However, rough calculations of the separation distances indicated that the hatch location was a little bit wrong for a trajectory from 15,000′. Flight drop-tests of the hatch and seat from a cargo aircraft confirmed the discrepancy. Taking into account that the trouble started initially while firing the aircraft gun at FL 470, and that high winds at altitude were such that the hatch could have drifted from FL 470 to its location as found, this possibility was explored. Sure enough, chemical analysis of the pilot's boots revealed gunpowder residue on the boots proving that the gun was still firing after the hatch had left the aircraft. Therefore, the hatch left the bird at FL 470 and not 15,000′.

Careful developing of approximately 500 bits and pieces of 16 mm film from a test camera, which was aimed at the bottom of the bird, further proved loss of the hatch at that altitude and time (one tiny 16 mm x 10 mm scrap of film provided the clincher). Even so the pilot honestly couldn't believe the hatch had left while at high altitude, so he requested to relive the entire flight by the sodium pentathol procedure. You have never heard a pilot complain about severe cold temperature like this one did while lying on a couch at plus 72°F. Establishing that the hatch came off at FL 470 led to a complete explanation of the accident.*

Failure to use and fit certain available evidence can also throw you a curve. Some investigators are prone to say "I can't explain that item, but I don't need it for my theory." This was the case when a single-engine fighter took off, flew low for about nine miles from the airport boundary, and crashed. A ground sweep of the flight path by more than 100 troops turned up a small part from the fuselage fuel-cell area on a hill quite some distance upstream from the point of impact. This brought about an interesting theory of an inflight explosion which was pursued for many days. This theory, however, didn't account for the unusual high-pitch whining noise made by the engine during and after takeoff, nor the excessive takeoff ground roll. Subsequently, a psychologist met with the troop who had found the part on the hill,

*The Bureau of Medicine and Surgery will publish an instruction covering the use of sodium pentathol interviews of post aircraft crash survivors in Navy aircraft accident investigations in the near future.

Take the case of a single-engine aircraft that lost all engine thrust on final.

and determined during the course of his interview that the part actually was picked up at the impact site. The entire investigation immediately changed course—and subsequent tests showed what made the unusual noise and caused the excessive takeoff run, and the eventual crash. Determination of the true cause factor brought about corrective action as in the previous cases.

Many times I ask myself "What is it that I would like to know about this accident?" Then I try to find some way to get it. For example, one test bird on final approach for no apparent reason landed short of the runway. We had our routine ways of telling that engine RPM was relatively high, but we couldn't tell if it was high enough to sustain flight. Although we were receiving telemetered data at the time, the data did not include thrust or engine speed. One of our technicians suggested that a special analysis of the telemetering records for first order engine unbalance, first order alternator frequencies and harmonics of both might permit determination of engine speed. As it turned out, the determination of engine speed was not successful because the filtering in the telemetry system for the removal of spurious noise was too good. The point, however, is that the idea of trying was good. Other investigation efforts brought about a solution to this accident, and corrective action.

When do you believe or not believe a pilot's story? I am not going into this but it reminds me of a single-engine, two-seater which lost all engine thrust

on final approach. Both of these gents soon found themselves parked in somebody's bedroom—and quite okay. One of the most thorough investigations followed because the engine and its fuel system were fortunately undamaged. After many days we were stumped because we had been through every inch of fuel system, fuel controls, and the engine, and had conducted a great number of test runs with the engine installed in another aircraft. No trouble could be found and I think each pilot wondered if the other had accidentally actuated the fuel shut-off valve switch and subsequently returned it to normal. Because we had run out of ideas to investigate, I had a mechanic-supervisor make a pickling run for temporary storage of the engine. Guess what happened? After several minutes of running, the engine suddenly quit cold with the mechanic's feet flat on the floor and his hands on the canopy sills. Further investigation defied a repeat or explanation. I have my own idea of the cause but the probability of occurrence is so low that I would never be able to prove it.

More than once a remark is overheard, and subsequently mentioned, with the result that it leads to, or supports, the solution of accident cause. One pilot made a comment to a non-technical friend during a dinner party about what he was going to try with the bird the next day. Too bad his dinner friend wasn't an aeronautical engineer because the tail parted company with the airplane. In another case, the two pilots of a multi-engine job had been overheard to say that they would change seats prior to landing. This comment, together with other evidence, supported inadvertent actuation of a specially installed test system switch as the cause of the accident.

Witness information can be good or bad but it always pays to weigh it and consider it carefully. Once we allow ourselves to develop preconceived notions we tend to hear and put weight on only those parts that fit our theory. As a rule, I value witness information more than many investigators. It has been my experience that much can be learned if the investigator is careful to avoid leading the witness into stating what the investigator wants to hear. If the investigator is experienced, he usually can tell which witnesses are providing valid information. However, except for triangulation, witness estimates of distance and time frequently are off quite a bit.

As an example, I had a problem develop after becoming airborne following takeoff and I had to chop the power. The terrain ahead was rough and I ended up inverted with a broken seat belt and sore skull. Of approximately 20 witnesses, all familiar with observing aircraft takeoff and land, some estimated my maximum altitude at 50′ and some said I never got off the ground. I figured I reached a maximum altitude of approximately 10′. As another example, we made two overhead test passes with a transport one night. The group of people on the ground consisted of laymen and accident investigators. No one in the group was aware that the two passes were at different altitudes—one being at 9500′ and the other at 15,000′. A point related to a particular accident was proved.

Supervisory error can take many forms, including aircraft maintenance, an on-the-job boss and the wife. Take the young pilot who was tagged with pilot error and pleaded for supervisory error on the basis that he never should have been graduated from flying school. Maybe he was right. Emotional stresses also have caused many accidents. I personally know of an excellent pilot who spun out on base-to-final because of an unjustified chewing-out he had received an hour before. Yet the report probably reads pilot error. Never forget the amazing things that can be determined by the aeromedical profession. It is possible for them to determine after a fatality the presence before death of certain drugs, carbon monoxide, smoke from fire, the bends, heart condition, and so forth.

Hazards of the language can cause some real dillies. Most everyone knows the story of the pilot's command to the copilot on a slow final—"takeoff power." The copilot took off power. In another one the pilot wanted to ground-loop a four-engine job to avoid going down the side of a hill at the end of his landing roll. He called "full power on four." He got full power on all four. Then there was the case during takeoff when the pilot said to his down-in-the-dumps copilot, "Cheer up." The gear came up, all too soon. Voice recorders in the cockpit will help investigators a great deal in many accidents. Most of all I like the story of the commercial airline captain who had just completed a difficult instrument approach, and said to his copilot "What I wouldn't give right now for a cold beer and a hot woman." One alert hostess quickly realized that the captain was unaware he was connected to the cabin P.A. and took off full speed for the cockpit—when a passenger hollered "Don't forget the beer."

In conclusion, I think the Investigator's Handbooks are fine—but I also think the investigator should add a lot of good thinking and ingenuity, and beware of becoming too mechanical. Another very important quality is to be objective and without prejudice. If the investigator is prejudiced, knowingly or unknowingly, another accident may occur before the next investigation is conducted in a completely objective manner.

MANUAL DEPLOYMENT

After a midair collision, the pilot of an AF-9J was subjected to severe flailing and negative G. He reached for the face curtain but could not get his hand past his helmet which was banging on the top of the canopy. After several attempts he got hold of the face curtain, then hesitated, hoping he could pull the curtain under positive vice negative G and be down on the seat pan before the seat fired. He fired the seat a few seconds later while still under negative G.

The pilot felt something hitting him in the posterior and thought he was bouncing in the seat. His helmet had slid over his eyes, probably due to a loose chinstrap and nape strap, and he was unable to see or feel the seat. Reaching behind his head, he grabbed the back of his helmet and pulled it off. He was falling on his back, his feet above and in front of him. The seat was gone but he could not see his parachute.

"I reached above and behind me," he stated later, "but I could not find it. I felt sure my rocket fitting had come loose. I started looking for my chute pack and D-ring, then saw it over my head. I reached for what I thought was the D-ring but instead it was the metal fitting that retains the harness in the seat. I started feeling up the riser for the D-ring but had initially reached above it and soon I had the parachute pack in my hands. I pulled the left riser from the pack, releasing the pin and chute. At the same time that I pulled the riser from the pack I looked down. The wind jerked the parachute out of my hands and as I reached for it again I felt the chute tug. I thought it was streaming and tried to look up at it but it blossomed just as I raised my head."

The pilot pointed his toes down, covered his face with his arms and went through a tree. Approximately 10 seconds after the parachute opened, he landed uninjured between the impact areas of the two aircraft.

Among the accident board's recommendations was that "the location of the D-ring during manual chute deployment be re-emphasized" and that "pilots be reapprised of the necessity for having properly fitted and securely worn flight equipment."

The parachute had failed to deploy automatically due to drogue chute failure resulting from suspected sunlight deterioration of the nylon shroudline eyelets.

Lost in Flight

On a weekend test hop for an RA-5C completing PAR, the test pilot (4000 hrs and 120 in model) filed a flight plan for a supersonic run in the Area of Positive Control (APC) then to continue for local checks on certain systems below the APC. No aircrewman was available to accompany the flight.

All instruments and radios checked out okay on the supersonic run. The pilot then dropped down to FL-185. The weather was VFR with heavy haze below FL120 where visibility was about 4 miles. The pilot noted that he could not see any prominent objects on the ground unless they were directly below.

Systems checks were commenced. When the emergency electrical power was tested with the main generators secured, the emergency power dropped off early and stayed off until speed was regained. This loss of power on the master flight reference allowed extreme G-2 compass precession.

Fuel was now down to 2600 lbs so, according to plan, the pilot started back to base. When the tacan needle said the base was dead ahead, the DME indicated 56 miles. Instead of decreasing, the DME increased to 60 in a few seconds.

The fuel was now down to 2400 lbs so the pilot started climbing for economy while checking on the UHF/ADF needle. It swung to the rear confirming the increasing DME reading. The pilot reversed course and followed the ADF arrow. While descending past FL160, the ADF needle began to spin while the DME continued to grow. Fuel was now down to 2100 lbs. Needless to say, confusion reigned.

The pilot called base RATCC and said, "I'm lost but I have a tacan bearing north of you at 40 miles."

RATCC said, "Squawk III-04."

"Roger but Center advised they didn't read my parrot," the pilot answered.

RATCC said he had a radar contact and gave the pilot a heading of 160 to steer to base and directed him to drop down to 4000′.

Enroute, the pilot said he was down to 15 minutes fuel and a positive radar contact would be reassuring.

RATCC requested a 06 IFF squawk. When the pilot complied, the ground station operator assured him

ANYMOUSE

The purpose of Anymouse (anonymous) Reports is to help prevent or overcome dangerous situations. They are submitted by Naval and Marine Corps aviation personnel who have had hazardous or unsafe aviation experiences. As the name indicates these reports need not be signed. Self-mailing forms for writing Anymouse Reports are available in readyrooms and line shacks. All reports are considered for appropriate action.

— REPORT AN INCIDENT, PREVENT AN ACCIDENT —

that the radar contact was closing the field. DME was also decreasing so the pilot was relieved as he descended.

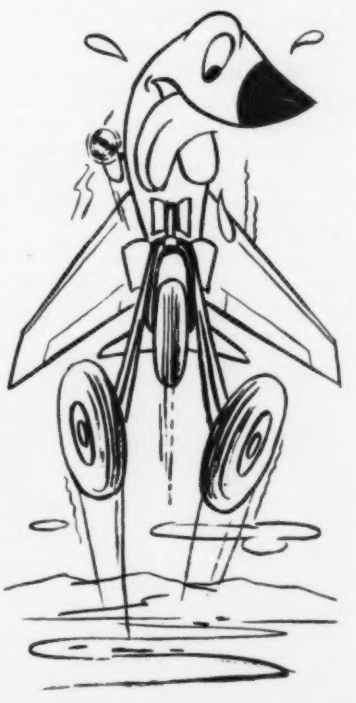
Suddenly, the DME reversed itself again re-alarming the pilot. Just then the pilot saw a triangular field which he knew was one of two outlying fields. Uncertain of which field it was, he informed RATCC of the sighting and added that he was going to try to squawk emergency. This required hitting an over-ride switch. RATCC acknowledged the new signal saying it indicated he was south of his base and advised that he turn right to 360 degrees. Almost without thinking the pilot began to bank.

Then the thought occurred to him that it should have been a left turn because his compass read 160 degrees. The Horizontal Situation Indicator (HSI) indicated a heading almost opposite from the wet compass. He hit the fast sync button and began to feel a little foolish as the instrument came alive.

The fuel gage now showed 1100 lbs; not a desirable amount for 30 miles at 4000′. Another base was nearer and the RA-5C got there with 500 lbs of fuel remaining.

Later checks revealed that the electronics man at NARF had not plugged in the IFF jumpers to the back seat console thereby restricting the pilot to the emergency IFF feature only. Moreover intermittent synchro circuit malfunctions caused the directional dilemma. Hereafter, this test pilot will check instruments and electronic equipment before they are urgently needed.

How Not To Keep Going



Enroute in an F-8 on an extended flight away from his home base, the pilot encountered generator failure. He reached his intermediate destination, however, by properly extending the emergency power package. All efforts to get the generator repaired locally for the return flight to the home base failed. While fiddling with the generator problem the pilot became aware that the aircraft's main emergency air bottle was empty. This the local NAS could and did refill. Fortunately, the pilot had suspicions as to why the bottle was empty and he observed its gage for a few minutes. Unfortunately, an unrepairable leak was evident and the bottle was empty again in less than a half an hour.

The pilot, now in a quandary that the local base could not fix the two discrepancies, began to have visions that a crew from his home base would have to be summoned. This routine would take many days and the pilot *was* impatient to get home.

Rather than wait for proper repairs, the pilot took off with the RAT extended. Additionally, and intentionally, he left the gear down because of no other way to blow it down in case of more trouble. These two external protuberances caused more drag than originally calculated so that a low fuel state required the pilot to land at a municipal airport a little over 100 miles short of his home base. The sudden availability of another ride to his home base prompted the pilot to leave the F-8 and not perform any more unorthodox flights.

Once home, the pilot turned the *Crusader's* retrieval problems over to the maintenance crew. The mission which instigated the flight, however was not completed until the pilot reported to another military air station. Consequently, he required the use of another F-8 which was summarily designated.

The assigned aircraft was not immediately available because another pilot had it airborne. To save time, the pilot filed an advance flight plan and made arrangements for a substitute plane captain to sign off a new yellow sheet. This short-cut plan did not insure automatic refueling of the airplane. Soon after the F-8 returned, the pilot hurriedly strapped in and blasted off. About halfway up to the assigned altitude a glance at the fuel gage immediately made the pilot wonder where all the poundage had gone. A wise decision prompted a return to base. The "full" *Crusader* gulped another full load of fuel and the mission was completed without further incident.

Anyone for tennis?

Reader Questions Headmouse Answers

Have you a question? Send it to Headmouse, U. S. Naval Aviation Safety Center, Norfolk, Virginia 23511. He'll do his best to get you and other-readers the answer.

Anti-G Suit Hose

Dear Headmouse:

I was at FL350 on a local tactics hop and in the process of maneuvering myself to the 6 o'clock position on the opposing F-8B. Previous G maneuvers had expanded the anti-G suit to its normal expansion for the G imposed on the aircraft, when additional G suddenly caused the suit to expand to the point where immediate relief was necessary to allow further breathing. With the aircraft in an inverted nose-high position, I pulled the first hose on the left rear portion of the console without success. Since the hose was of the same texture and approximate size as the anti-G suit hose, I assumed it to be the correct one. With two hands I was able to free it only to discover it to be the oxygen/communications hose. Subsequent lack of oxygen forced an immediate emergency descent to lower altitude, while at the same time I attempted to solve the initial problem.

CAVU weather eased the recovery problem and with the oxygen/communications hose reconnected, the hop continued.

This situation need not have occurred if soft hoses, vice the space suit hard hose, were available. The similarity between the two hoses could result in this recurring, possibly under adverse weather conditions when appropriate remedial action could not be taken. This occurrence could be prevented by restricting the use of this anti-G suit in aircraft cockpits configured as the F-8 aircraft are.

MAJOR S. A. CHALLGREN, USMC

▶ We can think of three explanations for the situation in which you found yourself. 1) Possible defective anti-G suit fitting. 2) Improper connection of hose which kicked out after partial suit inflation. 3) Defective system in aircraft. If nothing was wrong with the system and the hose was connected and functioning properly, the suit should have deflated automatically.

We cannnot agree that the soft hose is the solution. The soft hose collapses under positive G forces and restricts the flow of air to the anti-G suit.

Very resp'y,

Headmouse

Parachute Inspection

Dear Headmouse:

Since the majority of naval aircraft are on a 13-week (91-day) calendar inspection interval, why isn't there an authorized deviation for the parachute inspection to coincide? *BuWeps Inst 4700.2A, Change 3,* Chapter 8, paragraph 808.a(3) allows reporting custodians to deviate plus or minus one week or portion thereof from the authorized calendar inspection interval. *NavWeps 13-5-501,* Chapter 6, requires all parachutes in service to be inspected each 91 days with no provision for deviations.

LT E. E. WILSON,
QUALITY CONTROL OFFICER
TRAINING SQUADRON 3

▶ An inquiry to the Naval Air Facility, El Centro, produced the answer that the 91-day repack interval was set to coincide with the aircraft inspection interval and that the omission of the one-week deviation was an apparent oversight. The Naval Air Systems Command stated that they know of no reason why the repack cycle should not be extended by seven days and said that this item will be put on the agenda for the next Aviation Personal Survival Equipment Team (APSET) meeting.

Very resp'y,

Headmouse

A-1 Incidents

Dear Headmouse:

In spite of the A-1 being our oldest tactical aircraft still in use, the same old operational mistakes are prevalent. Here are some I've recently observed.

(1) A senior pilot who preferred comfort to full rudder throw was leading a section takeoff in a slight crosswind. His directional control was at a minimum and the wind got the best of him. Fortunately, he aborted the takeoff and regained control, but the wingman was a busy boy in avoiding a runway collision.

(2) Another not-so-experienced pilot let torque and wind zig-zag him down the runway before he finally got airborne off the side of the runway in a cloud of dust. This was the fifth such incident in recent weeks.

(3) A young A-1 pilot was conducting glide bombing practice and he was close to stall/spin speed when commencing the roll into a 30-degree dive. The change of direction added just enough G to spin the *Skyraider* one-fourth of a turn. Thanks to the model being responsive to spin recovery, control was quickly regained. Squadron policy had dictated an elevator trim setting of one and one quarter degrees nose down for such maneuvers. This pilot was using only one-half a unit nose down.

Have you any ideas on how to reduce these incidents?

FRAYED NERVE SAFETY OFFICER

▶ Just because a model has been in use for a long time does not mean safety teachings can be relaxed. Old minds forget and/or

get complacent while young minds must be taught and supervised constantly.

Very resp'y,

Headmouse

A-4 Strut Hangups

Dear Headmouse:

A-4 wheel hangups have been attributed to struts being filled with fluid, but no air. I disagree.

My point is this: A-4 main landing gear must extend all the way before they will go completely into the wheel wells. Once they go up, they will come down. Something else must have caused these wheels-up landings. What do you think?

AMH2 J. A. KREUGER
VA-153, FPO SAN FRANCISCO

▶ To retract, the strut must be fully extended. This doesn't mean the strut has to be filled with air.

Tests prove that an unpressurized strut will extend sufficiently to lock in the UP position. The weight of the wheels coupled with inertial forces when airborne tend to extend the strut.

But after the wheels are UP and LOCKED, a nonpressurized strut will tend to retract. Then when the up-lock is released the gear binds on the airframe structure. The photo below is a typical example. In this case the wheel jammed against the wheel well door when lowered. In the process, the strut mispositioned the catapult hook thereby preventing the gear from locking UP. The gear remained suspended about 10 inches. A wheels-up landing followed. There have been at least three cases of this.

Laboratory tests revealed the struts in all three of these cases to have insufficient air. No other defects were found—all were returned to service—all performed as advertised after proper servicing with air and oil.

Very resp'y,

Headmouse

Crunch Reports

Dear Headmouse:

Lately there has been a great deal written in APPROACH, CROSSFEED, and WEEKLY SUMMARY about incident and ground accident reporting. Being a graduate of your five-day safety school, I fully realize the importance of prompt and accurate reporting of all incidents/accidents, but exactly what criteria is to be used in reporting so-called crunches? Talking to other safety officers as well as officers higher in the chain of command makes me feel the consensus of opinion is "Why bother?"

The general feeling seems to be that since we have been crunching elevator tips, rudder tabs, etc. ever since carrier aviation began that we will continue to do so in the future regardless of the number of reports that are submitted. Consequently, many ground accidents occur but are not reported since damage is usually limited, requiring a small skin patch or possibly replacing a dented elevator cap. Our squadron alone has had as many as three crunches in one week aboard USS BOAT, and although that was an unusually busy week, I feel positive that other squadrons aboard other carriers have problems along the same line.

My point is, how are we ever going to improve the situation if those higher in the chain of command as well as squadron safety officers do not insist on every crunch being properly reported in accordance with OpNavInst 3750.6F?

Judging from your reply to the letter from "CRUNCHED MOUSE" in the November issue of APPROACH it appears that NavAvnSafeCen is interested in *all* crunches regardless of how minor they seem. If this is the case, would you please state the same in black and white so that I could use it along with OpNavInst 3750.6F as added fire power the next time anyone tries to keep an aircraft ground accident report from being submitted on a crunch.

ANYMOUSE

▶ OpNavInst 3750.6F is a Chief of Naval Operations directive. A directive is defined as a "military communication in which a policy is established or specific action ordered." OpNavInst 3750.6F requires reporting of all aircraft mishaps which includes crunches and other occurrences in which an accident potential existed.

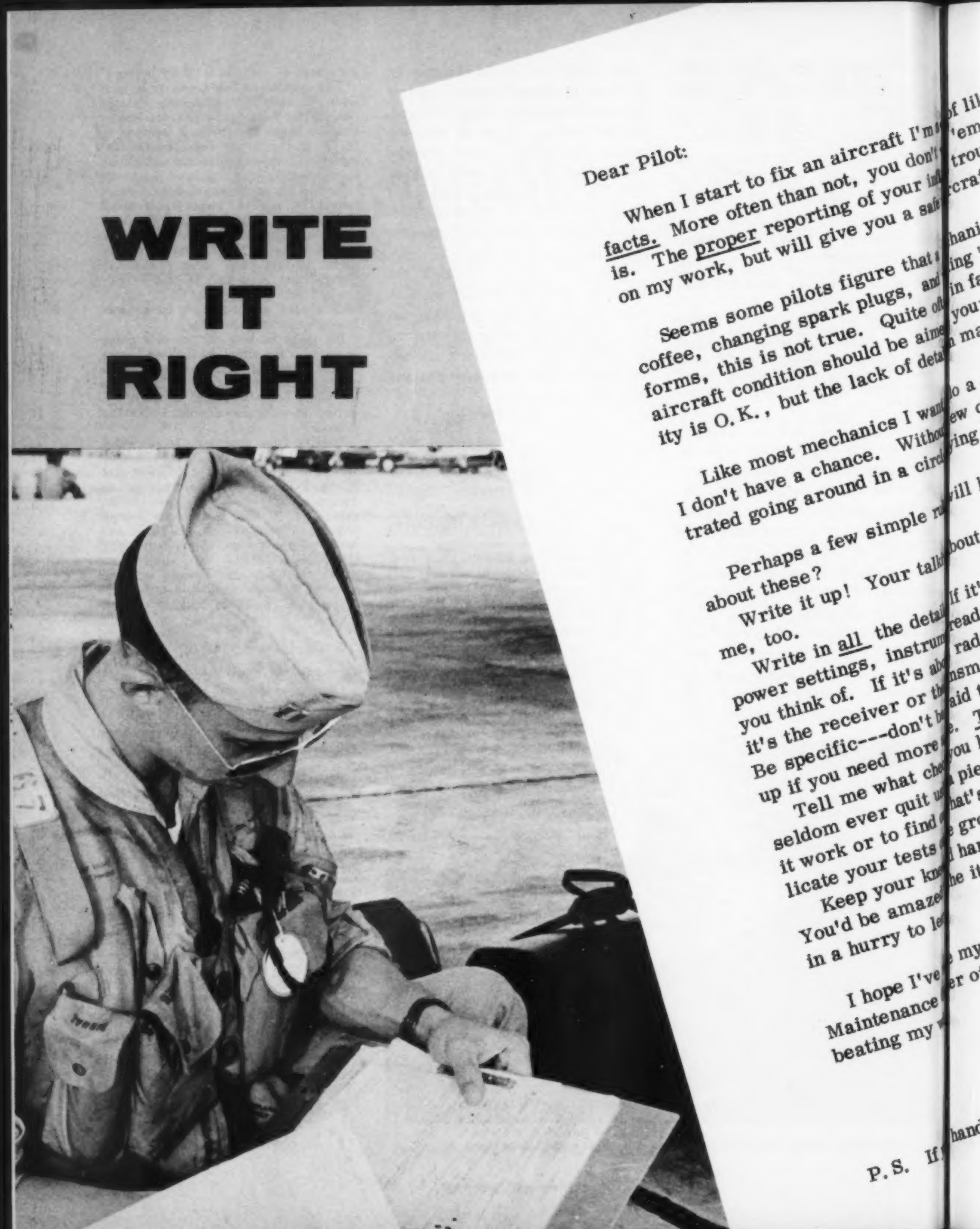
Reports generated by the 3750.-6F make possible analysis to determine correctable material and personnel deficiencies. For the accident prevention program to be fully effective, reports on all reportable mishaps must be received. Noncompliance with existing aircraft mishap reporting procedures is considered a direct violation of a lawful order.

Very resp'y,

Headmouse

Underinflated strut caused wheel hangup on A-4 wheel well door at point of arrow.

WRITE IT RIGHT



Dear Pilot:

When I start to fix an aircraft I'm f lik
facts. More often than not, you don't 'em
is. The proper reporting of your inf troub
on my work, but will give you a safe rcraft

Seems some pilots figure that hanic
coffee, changing spark plugs, and ing "
forms, this is not true. Quite of in fa
aircraft condition should be aime your
ity is O.K., but the lack of det n ma

Like most mechanics I want o a g
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Write it up! Your talk bout
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P.S. If hand

f like Jack Webb: I need the
'em to me---in writing, that
troubles will not only cut down
rcraft the next time you fly.

hanic spends his time drinking
ing "Ground Checks O.K." on
in fact, your grumbling about your
yourself. In some instances brev-
n many write-ups is bad.

o a good job, but without your help
ew clues I'm lost, and I get real frus-
ing to figure out where to start.

vill help to straighten things out. How

bout it with other pilots is fine, but tell

f it's about an engine, tell me the altitude,
readings, temperature, and anything else
radio, tell me which channel, and whether
nsmitter, and what kind of noise it makes.
aid to use more than one block for the write-
e. Tell me everything.
you have made and what the results were. You
a piece of equipment without some effort to make
hat's wrong. Remember, I may not be able to dup-
e ground.
d handy---write everything down as it happens.
he items you forget after you are on the ground and

e my point, sir. With your help maybe I can get the
er off my back, give my ulcers a rest, and even quit

Thanks,
Joe Maintenance

handwriting is POOR, PLEASE PRINT!

Courtesy of HelTraRon EIGHT

'I'll see you in the water!'

After an F-4B made its fifth unsuccessful approach in a night recovery, the alert tanker was launched. The F-4B's fuel state at plug-in was 1400 lbs. After repeated unsuccessful attempts at fuel transfer, with 200 lbs of fuel remaining the F-4B pilot detached from the tanker and commenced a terminal climb within visual range of the ship. Both pilot and RIO ejected successfully and were rescued. Here is the pilot's recollection of these events:

"When I was looking at what I would estimate at 150 to 200 lbs of fuel, I told the RIO we had had it and backed out. Previously I had asked the tanker to turn toward the ship which he had done very nicely. I thought we were crossing the bow. Our altitude was 3500′ at that time so I pulled the probe in, went to 100% and started a fairly steep climb with an airspeed of approximately 280 to 300 kts. We crossed what I thought to be the bow of the ship at about 6000′ and proceeded until the fuel tape was finally just barely visible and our altitude was about 9000′.

"'Eject at your discretion!' I told my RIO.

"'Rog, I'll see you in the water!' he replied, and out he went.

"I hung on just a little longer. I think I climbed 1000′ or more, and then I noticed that I was beginning to accomplish nothing as I'd crossed the bow and was opening from the carrier. I put my head back, reached for the face curtain, and as I expected, with my head back I couldn't get to the face curtain. I leaned forward and pulled the curtain out until my fists cleared the forward round of my helmet. Then I tried to push my head back against the head rest, but there wasn't enough room. Somewhere between pushing my head back and pulling more curtain out, the seat fired. I can remember distinctly feeling the interrupt when the canopy went.

"When the canopy went, my fists were almost in front of my eyes. Immediately afterward, the seat fired. I don't have a good recollection of the next five to eight seconds, but I was not impressed with the wind blast; I can barely remember feeling it. I know I was tumbling but I don't know whether it was over backwards, frontwards or sideways. The tumbling was noticeable but not violent.

"The chute opened with a mild jolt and, as far as I can remember, my feet were pointing straight down at the time. It was dark, of course, so I couldn't really tell. Opening shock was solid but mild. I found myself hanging in the chute, both hands still firmly gripping the face curtain. I looked at it, decided it was of no use and threw it away. This was my first realization that I was in a parachute. It was like I

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AVY

thought it would be—quiet, with a little more wind force and mild oscillations.

"Immediately after I'd realized I was sitting there with the curtain in my hands, I looked off to the left and saw the airplane descending in a steep nose-down position. There was a ship in the direction it was going but I'm sure the plane never got to it. The lights were still on the last time I looked.

"I expected a rapid descent but time went on and on. My mask was still in place—it was just pulled down a little bit. I suppose I was breathing through it—I didn't pay much attention. I unhooked both sides of the mask and, after deciding it was of no value to me, I threw it away. I checked my helmet chinstrap; it was a little loose. Inflation of the Mk-3C life preserver went as advertised. I had no trouble getting to the handle on the seat kit. I pulled it and everything fell out of there like it was supposed to. I was oscillating some at the time and I think that the raft had a dampening effect because when I would swing right, the raft would be to the left and vice versa. About halfway in my descent, the oscillation stopped.

"It was a fairly comfortable ride. For lack of recalling exactly what I should do, I decided to leave both lower fittings connected. Then I started to fish around for things. I pulled my shroud cutter out and checked it; it was on a lanyard. I shoved it back in the hole. Then I noticed I still had my flashlight even though I had gone out with the thing swinging loose on a lanyard around my neck. I shoved it down inside my mae west.

"Then a disconcerting thing happened. I reached for my upper rocket jet fittings and I couldn't find them. I nearly panicked. I was reaching all over my chest but I couldn't find my rocket fittings. Finally I took my flashlight out and turned it on and started looking around until I found the fittings up by my head. I should have remembered this would happen. I shut off the flashlight and put it back.

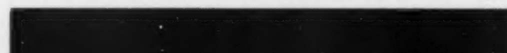
"About the time I could see the white caps, I was all engrossed making a quick check of flares, flashlight and pistol. While in the process of doing this, I hit the water and the impact nearly knocked me out. A white flash ran across my brain. I went under but not for very long.

"When I came back up, I reached the left fitting. While I was trying to locate the right fitting, the wind picked up the chute which started to drag me forward. It forced my head under water so I reached up and pulled my helmet off. As soon as I got my helmet off it was easy for me to get my head back while I was still underway. The right fitting released easily and the chute collapsed.

"While I was sitting there in the water, I said to myself, I'm not going to do anything until I try to figure out what has transpired. I noticed I was holding my helmet so I put it back on. Then I realized that the wind had blown me toward the chute. I took the seat pack off and put it in the raft. I realized I was getting tangled in the chute. I could feel the risers around my feet. I almost panicked at that point of the game because it was dark and all I could do was feel. I crawled into the raft and left my feet hanging over the narrow end. I had no trouble getting aboard. Then I very laboriously peeled all the shroud lines off. I decided to pull in the lanyard to the survival kit but the lanyard was all wound up in the chute. If I had to stay there for any period of time I was going to cut that lanyard as it was tending to tip me to the right.

"While I was pondering the problem of cutting the lanyard, I looked off and there was a pair of headlights coming my way. I took out a flare and fired it by pulling straight out. It worked beautifully. The helo came right by, then he went up and turned. It looked like he was hovering over someone so I got the other flare out and fired it off the same way. When the flare had burned out, it didn't seem like the helo had moved an inch so I decided to use my pistol.

"I could not get my pistol out. I could get my hand to it but the hammer was hooked on something; I



couldn't tell or feel what it was and I couldn't get my head around to take a look at it.* I didn't want the helo to get away so I took my strobe light out and started waving it. As the helo approached me, I could hear the bull horn signal 'Get away from your chute.' Then he said, 'Get out of your raft.' I really hated to get out of the raft.

"The helo had a difficult time getting the seat down to me. The swells were pretty high, I would say about 8'. The pilot would put the seat in the water and all at once it would be 6' out of the water, then in the water again. Finally I decided that I would wait and let him get the seat to me. I had tried to swim to it about three times and realized that I was going to get tired quickly. He finally got it to me although I had to swim 6 or 8'. I would say it took 10 minutes or more from the initial approach. As I got to the thing, the swell dropped out from under me and I was just hanging on with my hands. I decided to hang on until clear of water and if it didn't come back down, to let go. It came back down. I climbed aboard, threw a bear hug on it and up we went.

"For some reason he held me down about 15' to 20' below the helo for a long time and I started oscillating from that. (The helicopter, I learned later, was having hoist grip control troubles.) It seemed pretty bad to me but was probably exaggerated in my mind. The oscillations dampened as I got closer to the helo. I almost hit the fuselage under the right seat pilot on one swing.

"As they swung me into the helo, the crewman let me just sort of hang gently outside the door. I didn't want to sit out there so I reached around the seat shank with my right hand and grabbed my harness, reached back to the helo with my left hand and pulled myself in."

The RIO had ejected normally after pulling the face curtain. Parachute opening shock was very slight. Once in his chute, he inflated his Mk-3C life preserver and deployed the RSSK-1 seat kit. The raft dropped out but did not inflate. He then noticed that he could not look up because the roller yoke and harness webbing was pressing against the back of his helmet. With his left hand he pulled the webbing over his helmet so that he could move his head. During the descent he experienced severe oscillations which he found he could control by pulling on his left forward riser and right rear riser.

* At the time of this accident the .38 revolver was carried on the squadron's survival vest in a cloth holster on the right side with a cloth strap snapped over the hammer to hold it in place. The pilot didn't know this retaining snap was there.

When he entered the water, at first he could not release his rocket jet fittings and was dragged somewhat by the partially-collapsed parachute before he could get free. He had to grasp the riser with one hand and release the fitting with the other.

Once free of the chute, he turned on his strobe and mercury lights. He then fired four tracers and ignited a Mk-13 Mod 0 night flare. His flare and strobe lights were spotted by the helo aircrewman. He released the right side of his RSSK-1 kit and attempted to retrieve his raft which had sunk. (It had not inflated on RSSK-1 deployment.) After three unsuccessful attempts he gave up because he was becoming fatigued. The helicopter arrived a few minutes later and by loud hailer informed him they had him in sight and would return after picking up the pilot who was close by.

Several minutes passed and, having some doubt as to whether his position was still known, he reloaded his pistol and fired four more tracers. He noticed that the velcro tape holding his strobe light on his shoulder had come loose and the light was in the water. He then held the strobe upright at arm's length. A second helo arrived and he ignited another night flare. (It was during this time that the first helicopter was having difficulty retrieving the pilot.)

When the RIO realized that the second helo had him in sight, he released the left side of the Scott kit, allowing it to fall away. After several approaches the helo crew put the rescue seat in the water very near him and he was hoisted aboard and returned to the ship.

"The helicopter crews are to be commended for the expeditious recovery of the aircrew from the water under adverse conditions of darkness, turbulent air and rough seas," the investigation board stated. "The failure of the helo crewman's hoist control grip during retrieval of the pilot understandably added to the pilot's anxiety as he swung beneath the helicopter. The quick resort to alternate and emergency methods of operating the hoist is indicative of the helo crew's high state of training."

Readiness in Reverse

By the light of a flare, his wingman saw Dash-Two pass across the target. . .

The A-4 Tactics flight was briefed at 2140. The mission was 30-degree night bombing, using aircraft dropped flares for illumination. Two Skyhawks *were to practice the attacks while Lead flew a racetrack pattern over the target, dropping the flares and acting as coordinator. The briefing was thorough, with special emphasis placed on procedures to be followed in the event that a pilot became disoriented in the bombing pattern. The procedure was to immediately abort the run, transition to instruments, climb to 10,000′ and orbit the target.*

One month prior to the flight, the pilot of Dash-Two had checked into the squadron from a combat proficiency billet. Following a stint in the Training Command and 1600 hours of flight instructor time, he had spent a year in a proficiency status before returning to an operational outfit. His skill in jet aircraft was unquestioned, since he had accumulated over 2500 of his 3100 total flight hours in jet aircraft.

The flight launched at 2258 and proceeded to the target area at 8000′. Once there, Lead detached, descended to 5000′ and commenced flare drops.

The first two flares were duds. The third lit off, but was too far from the target for acquisition. The fourth flare ignited over the target.

He was doing well in the A-4 and making the most of the limited time available for training in a

truly professional manner. This particular flight was his first refresher night hop in the last three months, *and his first night flight in model.* Nonetheless, he was piling up the experience. Prior to this hop, his accumulated A-4 time totaled just short of 25 hours.

Dash-Two, at the 90 degree position, called, "Target in sight, rolling in." His wingman in Dash-Three observed the run-in and noticed that it was a bit steeper than the 30-degree dive angle that had been briefed—closer to 45-degrees.

He was aggressive and had a strong desire to fly, as attested by the fact that he flew any aircraft available during his staff and proficiency billet assignments. He also voluntarily extended his overseas tour in order to join the squadron and accompany it into combat in Vietnam. When he checked in, the squadron had nearly completed refresher training and was about to return to the line.

Both Lead and Dash-Three then heard, "Dash-Two off, aborting." His wingman saw Dash-Two pass across the target by the light of the flare, but could not judge his altitude, or the attitude of the aircraft.

The pilot's special instrument card had expired two months previously at a time when he was assigned to a combat proficiency billet and did not have an opportunity to renew the rating.

Dash-Three rolled in and made his first run, but developed an extreme case of disorientation on the pull-out. As briefed, he transitioned to the gages immediately and recovered at altitude. The recovery took him high and wide, and after levelling off and reentering the pattern, Dash-Three found that he now had only the lead aircraft in sight. He requested Dash-Two's position, but when he received no response, he set up an orbit and both aircraft attempted communications . . .

All of the pilots who had flown with him during his tour in the squadron had found him to be extremely capable. His progress through the training syllabus was eminently satisfactory in all respects. He was a highly skilled, competent, well motivated aviator.

Following a joinup and several fruitless circuits of the area, the flight returned to base. Once it was confirmed on deck that Dash-Two had not been sighted or in communications with homeplate, Lead requested SAR assistance.

Following a thorough search, rescue units confirmed that the aircraft had crashed and sunk with the pilot aboard in 50 fathoms of water, 10 degrees off the run-in heading and less than 2 miles beyond the target.

In wartime, devotion to duty and concern for the task at hand can deepen a man's enthusiasm and increase his reluctance to stand aside—even though he knows that he may be overcommitting himself. Under normal operating conditions, opportunity often provides the stimulus for a like reluctance to say "no," but certainly the same altruistic reasons don't apply. In either case, conditions which are clearly adverse to readiness may come about when standing commitments are increased, chiefly because of the human factors involved in implementing them.

In a wartime situation, for example, the constant, pressing need for trained personnel may be caught up with command reluctance to admit to being overcommitted and understaffed; and too often, this unholy mixture is swept along in a tide of paperwork past good judgment and honest achievement. In some recent instances the need for pilots has occasioned an accelerated retraining program for aviators considered to be above average in ability and/or highly skilled in other model aircraft. But no matter what their experience, expediency can be mother to progress only under very favorable conditions; and although the effects of this haphazard approach to training are nearly always hidden for a time, its results have all too often been disclosed by another needless loss of life.

Crusader Punchout!

Time telescoped events for a pilot who parted company with an F-8E in the air not so long ago after generator failure, explosion and fuel fire during aerial refueling.

"From the generator failure to the ejection . . . seemed like less than a minute," he reports. With the smooth pull of the face curtain ejection was instantaneous at 11,000′.

"I had no sensation of the canopy going first," he states. "No sooner had I pulled the curtain than I felt myself tumbling through the air. Seat acceleration was noticeable but not uncomfortable."

As observed by his wingman, seat separation and parachute opening was instantaneous. However, the pilot's time sense reversed and it seemed that it was taking so long that he began to think the seat had failed to function automatically.

"I tumbled for what seemed like 10 seconds or more without stabilizing or the chute opening. I still had the face curtain in my hands and observed that it was over the right side of my head and right shoulder. This had happened to me before in dry ejection runs when the face curtain restraining line caused the face curtain to end up on the right side of my head instead of over my face. This is due to my long torso length."

He let go of the face curtain and looked for his parachute pack and seat. When he felt some straps behind him, he decided he was still attached to something and looked for the emergency harness release handle. At this time he felt the seat separate although he never saw it. He let go of the straps and braced himself for the chute opening which occurred immediately.

With a good canopy above him except for a small tear in one of the panels he took off his mask and gloves and looked around just in time to see his aircraft hit the water. He then pulled the seat pack handle, deploying the raft and equipment at an altitude of 5000′.

This move proved to be a mistake because the inflated raft and equipment acted like a pendulum, setting up large scale oscillations. Updrafts also caused the raft and equipment to move vertically and several times he was struck by the raft. Every time the equipment fell to the end of the line attached to him he got "a pretty good jolt." He tried to pull all this gear back up and hold on to it. This stopped the oscillations but the raft flapped around so violently that he finally dropped everything again and "accepted the uncomfortable ride" although it was beginning to nauseate him. Checking himself over, he found no injuries. In preparation for his water landing, he inflated the Mk-3C and located the Koch fittings which were "alongside the top of his helmet." Wind direction was almost impossible to determine because of the oscillations and jolts and the absence of white caps. He took a 50-50 chance, turned facing the direction he thought the swells were coming from, and found he was wrong.

"I hit the water very sharply at the top of an oscillation, buttocks first, nearly horizontal, with

my back to the wind. Just before landing I had the sensation of drifting very rapidly across the surface of the water. While underwater I released the left Koch fitting and, immediately on surfacing, easily released the right one. I saw the collapsed canopy about 10′ away from me and the raft very close by.

"I swam a few strokes away from the chute to keep clear of the shroud lines, turned the raft upright and unsuccessfully attempted to board it. I had forgotten to release the remaining part of the seat pan and my legs got a little tangled in the line attached to the raft and equipment. I easily released both rocket jet fittings and the seat pan dropped away, pulling the line free from my legs. I observed at this time that my shroud cutter located on the inside of my left thigh on my anti-G suit was poorly positioned. The bulk of the Mk-3C made it difficult to reach this area. I intend to relocate my shroud cutter on my upper left shoulder where I will be able to reach it with either hand."

On the subject of releasing both rocket jet fasteners on his seat pan, the board commented, "If a wave or a gust of wind had taken the raft from his grasp, he might have lost it and all attached survival equipment. A pilot should release the seat pan rocket jet fastener on the side in the direction he will roll his body when boarding."

"With the seat pan disconnected, I easily boarded the raft," the pilot continues. "While I was boarding, I noticed that dye marker was already in the water. Although I never did find the source, I assume that a dye marker packet ruptured on hitting the water. (*It was later determined to have been from the left side of the Mk-3C.*) The dye marker continued to color the water for the hour or more that I was in the raft and made a 100′ long stripe, 2 or 3 yards wide. Only 30 seconds or less after I hit the water, I was sitting in the raft. I endorse inflation of the Mk-3C prior to a water entry because I went only a very few feet underwater and immediately returned to the surface where I floated quite comfortably.

"After boarding the raft, I waved to my wingman who had been circling me during the letdown. Again I checked myself and found no apparent injuries. With dye marker already deployed and the wingman and a C-54 circling me, I took a few minutes to rest because I suddenly felt exhausted.

"I didn't rest very long because I started feeling seasick. The raft was floating parallel to the swells which were about 4′ high. This was very nauseating and I had to hold on to keep from rolling over the side of the raft. I found a line attached to the side of the raft and hauled up my survival equipment, sea anchor and the top part of the seat pan which I had released before getting into the raft. The sea anchor was attached to the side of the raft and had caused the raft to ride parallel instead of perpendicular to the swells. (*The sea anchor should have been attached to the bow. All others in the squadron were checked and found to be attached correctly.*) Seasickness was becoming more of a problem so, not wanting to attract sharks, I found a large plastic water storage bag in the equipment container and spent about 10 minutes vomiting into it.

"Following that unpleasant experience, I cut the line attaching the seat pan and jettisoned the seat pan. (The sea anchor had become entangled with the lanyard during descent.) I inventoried my survival equipment after deploying the sea anchor again. All of the equipment was properly attached. I located the PRT-3 and found it correctly connected but with the plug still in. I removed the plug and started to connect the rigid antenna when I got an electrical shock. Since the raft was swamped and it was impossible to bail it out due to the swells, I couldn't keep the PRT-3 dry. I got all of the electrical connections out of the water but every time I touched either the battery or the radio pack I got shocked again." (*It was later found that the plug had been pulled out far enough during seat separation to actuate the PRT-3. At least one pilot heard the beeper during parachute descent.*)

The pilot flashed his signal mirror at the circling aircraft. Two of the pilots reported seeing the flashes. When a helo appeared, he got his day/night flares out of the seat pack and found they were tied together. He cut the line and actuated a day smoke flare. When the helo lowered a rescue seat, the pilot left his raft, swam a few strokes to the seat, and was hoisted into the helo. He was uninjured.

"The only additional comment I have concerns my initial diagnosis and reaction when the emergency occurred. As I stated, I thought I had experienced a midair collision with a subsequent flameout. The seat-of-the-pants sensations and instrument readings were confusing to say the least. The fire, loss of control, rapid altitude loss and very short time lapse from routine operation to critical emergency (30 seconds) allowed no time for trouble shooting or postponing the final decision. I feel now that I probably stayed with the aircraft longer than I should have, but the conditions that the other members of the flight saw and the action required were not known to me."

NOTES

Zero pitch angle provides very little prop wash warning.

Turboprops

THE prop hazard of the E-2A was recognized before its introduction into the fleet. Now the first prop injury involving an E-2A has been reported. Fortunately, it was not a fatality.

During a ground maintenance turnup of an E-2A, the night check operator signaled a plane captain serving as taxi director to enter the aircraft. The night check man had closed the main entrance hatch to keep the noise down. He heard the plane captain trying to open the hatch and after a few moments when the noise increased, assumed the door was open. When the plane captain did not show up in the cockpit, the night check operator looked out the window and saw him lying on the ground.

There were no witnesses to the accident. The plane captain had been struck in the left shoulder. He remembers having difficulty with the door handle, then a blow on the shoulder like a sledge hammer. He remembers nothing after that.

Besides his shoulder injury he also had a cut on the nose. A small amount of blood was found on the door and fuselage. It was theorized that he either backed up too far trying to open the door and was struck by the prop and thrown into the door, or the door opened, striking him on the nose and causing him to back into the prop.

"This is the first known propeller accident involving the E-2A," the squadron commanding officer's report states. "Miraculously the man suffered only moderate injuries. An active and vigorous education program on prop safety will continue to be one of the most important aspects of this command's overall safety program."

When a turboprop reaches the zero pitch angle there is very little prop wash to warn you of its presence. Consequently you will not be as conscious of the danger as you would with conventional reciprocators. *Take care around all props, and because of the absence of prop wash be extra cautious around turboprops.*

Trainee Trapped

AN incident in which a trainee was trapped in a Dilbert Dunker underwater has been reported. As the Dunker submerged, a sudden kink in the oxygen line cut off the oxygen to the trainee's mask. He immediately signaled to the attendant, an ADRAN, and proceeded to release himself from the seat. As he twisted to exit, the straps of his back pack became wrapped around his neck. This plus the fact that he was between the Dunker and the rails made it impossible to raise the Dunker from the water. The trainee states that the ADRAN's rapid and effective action in freeing him from the seat saved his life.

The trainee recommends that an oxygen bottle with an extension cord be kept on the edge of the pool for use in such mishaps and that the safety swimmers in the pool be required to carry a knife to cut straps or webbing which hamper movement from the cockpit.

(Some Dilbert Dunker facilities are already equipped with an oxygen supply, and stainless steel tools for freeing trapped individuals are kept on the bottom of the pool under the Dunker.—Ed.)

One-Half Inch Tape

AFTER ejection and water rescue, a pilot who had accidently

FROM YOUR FLIGHT SURGEON

cut shroud lines securing his personal survival equipment recommended that lines used for this purpose be dyed a color. In this way, he said, a pilot could at least distinguish equipment lanyards in daylight.

The Naval Aviation Safety Center suggests that personal survival equipment be secured with some kind of flat tape instead of with shroud line. Tape can be distinguished from shroud lines by sight in daylight and by touch in darkness.

No Rings

AFTER preflighting the port transmission area of an HC-1, the pilot jumped from the cabin deck to the ground, a distance of about 3½′. His left ring finger was cut when his wedding band caught on the door latch. The wound required 15 stitches.

"In the past," the squadron commanding officer wrote, "incidents of this nature have resulted in far more serious consequences. To preclude similar occurrences, all personnel of this command are prohibited from wearing rings while working on aircraft. This policy applies to pilots and aircrewmen as well as maintenance personnel."

Tell Somebody

THE pilot didn't have a lot of jet time, but he was far enough into the transition program to be on a solo mission. About 40 minutes after takeoff he started to feel "woozie." His thinking was getting fuzzy.

He went to 100 percent oxygen and started down toward the traffic pattern. But as he approached the field he began to feel better. Climbing back up to continue his mission, he again noticed the odd sensations as he passed 10,000′. Back to 100 percent and back to the field, this time for a full stop landing. After the flight he reported "an alarming sense of well being during the landing."

Simple case of hypoxia, you say? A second look at this incident gives us cause for more than usual concern. This student's second attempt to complete his mission after he experienced hypoxia symptoms reveals more than misdirected enthusiasm. When he pressed through the landing without telling anyone about his troubles, he showed that he wasn't aware of the seriousness of it all.

With many people who are new to or getting reacquainted with high altitude operations, we must constantly remind them that hypoxia and hyperventilation (the symptoms are often similar) try to hide their own deadly presence. After getting 100 percent oxygen and slowing your rate of breathing at the first hint of a symptom, the next most important thing is to tell somebody about it.

You need outside help!

—*TAC Attack*

Saves Face

AN A-4C pilot who ejected over the desert after a midair collision had his visor down during the accident. When he landed halfway down the bank of a dry gully and rolled to the bottom the helmet visor broke. Although the pilot's face was cut superficially, the investigating flight surgeon reports that the visor undoubtedly prevented more serious injury to his face and facial bones.

Eye Damage

FOREIGN body damage to eyes is increasing aboard carriers, a safety council reports. The area aft of the island seems to be regarded as a safe area by personnel aft. Fifty percent of the minor flight deck eye injuries are traceable to this area, the council notes.

Solution: "Stronger control of flight deck personnel as regards to wearing goggles."

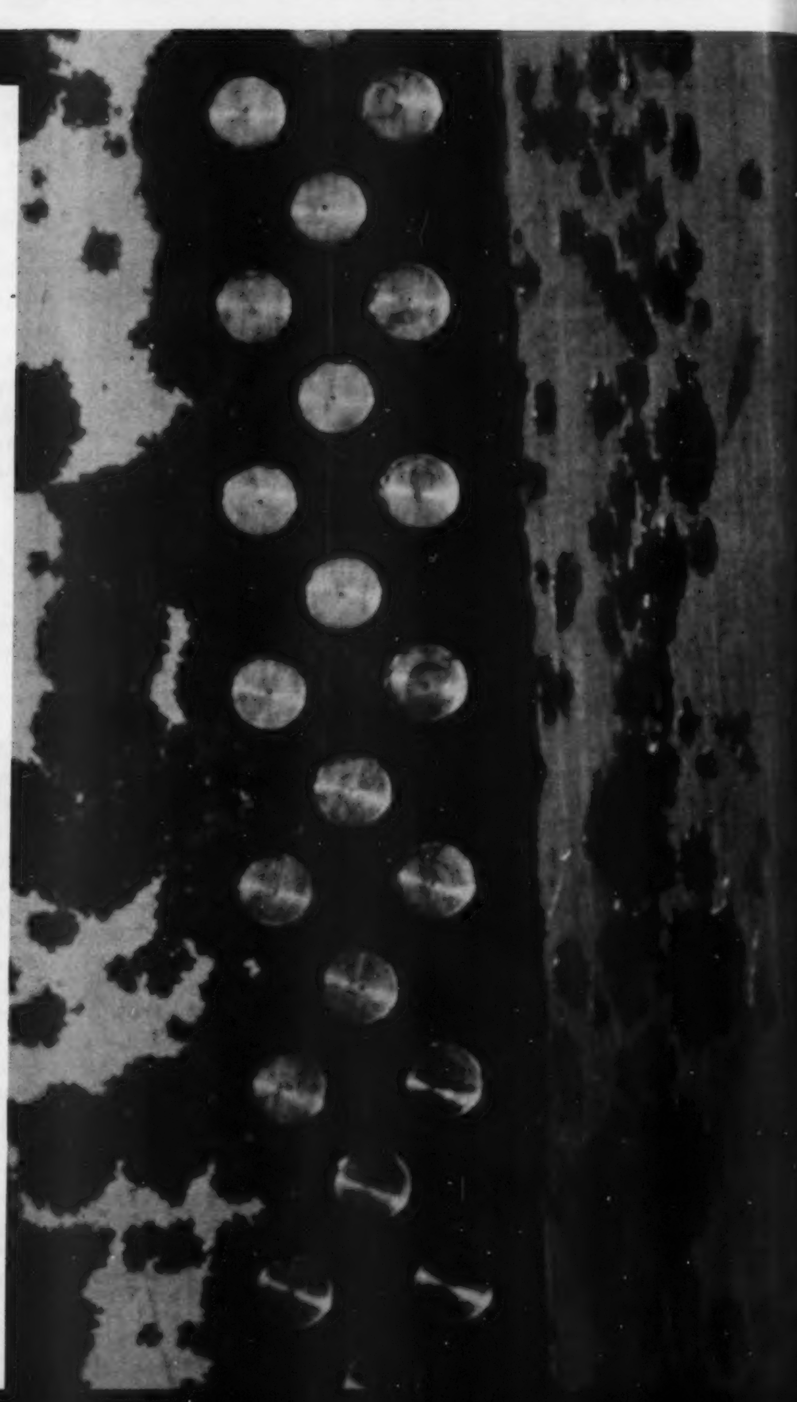
Rocky Touchdown

PARACHUTE opening shock after ejection was much harder than the A-4 pilot had expected. The left strap of his oxygen mask popped off and he nearly lost his helmet.

During descent he was unable to stop a rather rapid drift toward an area of hard lava rock. He landed very hard swinging from right to left. The outside of his left heel struck the rock with enough force to throw his hard hat to the ground. As he fell the back of his head hit the rock. He was not knocked unconscious but the "brisk bleeding" from two superficial cuts alarmed him at first.

The pilot had not tightened his helmet chin strap prior to ejection.

CORROSION



Corrosion from exhaust (lead bromide) on lower side of wing of recip-engined transport. This C-118 did not have a regular cleaning schedule and protective finish was not maintained. Note intergranular corrosion on spar cap at right.

AND ITS

CONTROL

By AMEC W.F. Koons, Staff, ComNavAirLant

Corrosion prevention is by far the most practical method of dealing with corrosion. Consistent preventive maintenance will effect savings in labor and materials by eliminating the costly repairs and replacements required when corrosion has been permitted to go unarrested. Likewise the benefit to aircraft availability is always one of the most obvious advantages of superior maintenance.

In nature, the forces that cause corrosion are constantly in action. Everyone has seen corrosion turn useful structures into crumbling skeletons, productive machines into frozen hulks, automobiles into piles of junk. It dissipates our resources and the fruits of our labor. It interrupts production. It causes accidents. It costs us money.

Different metals are affected in different degrees and corrosive attack takes many different forms. Attack may be by general tarnishing or rusting with occasional perforations, or may develop preferentially near the junction of two different metals. The metal may suffer highly localized attacks by pitting. The strength of a metal may be destroyed by cracking induced by corrosion. Corrosion may also be confined to crevices, under gaskets or washers, or in sockets. It may have the effect of removing one of the constituents of an alloy so as to leave a weak residue.

Corrosion and its control are matters of increasing concern to all activities operating aircraft. With high strength demands being made of metals, the prevention of weakening from corrosion becomes correspondingly important. Extreme corrosion cannot be tolerated from the standpoint of safety or costly time-consuming replacement and repair. Preventive maintenance is a must to police sensitive areas in an effort to prohibit inception, and to detect and arrest in the early stages any corrosion that does start.

Corrosion Defined

Corrosion is defined as deterioration or destruction of metal, caused by chemical or electro-chemical reactions between metals in association with nonmetallic substances in the atmosphere that initiate and conduct the reaction.

Conductive mediums, such as water, are necessary for corrosion to occur. Among the most common corrosion promoters are moist air, salt water, soot, gases and acids dissolved in water.

Metals have a tendency to react with moisture and other substances to form compounds. In this process, metal undergoes chemical or electrolytic changes that destroy the form, strength, or mechanical property of the original metal. The common cause of corrosion is this reaction, or oxidation, between metal, air and moisture. If salts, gases, or acids are added to this reaction, the corrosive action becomes accelerated. All metals are susceptible to corrosion to some degree. Therefore aircraft that operate in marine environments especially require corrosion control because of severe atmospheric conditions of temperature, humidity, and the extremely corrosive salt-laden air and water.

Nature of Attack

There are two general types of attack—*direct chemical* and *electro-chemical.*

Direct chemical is where the anodic and cathodic changes take place at the same point on the metal, such as; when salts and acids or both come in contact with the bare metal, causing the metal to be eaten away or direct reaction of a metal surface with oxygen in the air.

Electro-chemical involves an action wherein the anodic and cathodic changes occur at a perceptible distance from one another. All metals have an electrical potential which is determined by the composition of the metal. The greater the electrical potential,

the greater the attack. Three conditions must be present for an electrochemical attack:

- two or more points of metal to act as electrodes;
- an electrolyte to act as a conductor and;
- an electromotive-force (EMF).

With these conditions present, a chemical cell is produced such as in a dry cell battery.

Factors Affecting Corrosion Control

Materials—All high-strength, heat-treatable aluminum alloys are susceptible to intergranular corrosion as well as pitting and general attack.

Heat treatment—Heat treatment of material is a vital factor in establishing resistance to corrosion, due to slower reaction of heavy masses during quench cycle of the heat treat process; thicker sections are normally more susceptible to corrosion than thinner sections.

Environment—The corrosive effect of environment is determined by the composition of the corrosive materials and length of time they remain in contact with the metal. The environmental factors are within the control of the operating activity and offer a positive means of corrosion prevention. It is of utmost importance that aircraft be kept thoroughly clean at all times. A definite time interval should be set for cleaning. It is recommended that this be based on calendar time, rather than flight time to provide equal interval for all aircraft. It is necessary that a conscientious regard for special environments be developed, and cleaning operations adjusted accordingly.

Preventive Maintenance—Effective *proper* maintenance procedures on a conscientious day-to-day effort is essential to prevent and control corrosion and requires the following:

- frequent cleaning according to operating environments;
- effective and frequent inspections;
- inhibition of corrosion immediately after detection;
- effective sealing of seams that present possible entrapment of electrolytes;
- insulating between dissimilar metals;
- proper lubrication;
- maintaining drain holes open;
- maintaining good protective coatings and;
- use of supplementary protective coatings where-ever possible, such as: Corrosion Preventive Solvent Mil-C-16173.

Common Corrosion Products

One of the basic problems in corrosion control is recognizing corrosion products when they occur. It is evident that one must know what each type of corrosion product is in order to provide effective corrosion arrestment. A brief description of typical products characteristic of the more common materials of aircraft construction follows:

Iron and steel—Red rust. Its appearance is an indication of inadequate maintenance and that a more stringent program should be followed.

Aluminum—White to gray powdery deposit. In general, under Navy operating conditions aluminum requires protective barriers and supplementary protection.

Magnesium—White and voluminous compared to the base metal being corroded. When failure of protective coatings on magnesium occurs, corrosive attack tends to be severe in the exposed areas and may penetrate entirely through a magnesium structure in a short time. Any corrosion of magnesium requires prompt attention and complete removal of all corrosion products.

Titanium— Generally corrosion-resistant. A maintenance program should provide for periodic removal of surface deposits of marine salt in order to minimize high temperature deterioration.

Copper—Blue or green salts. Generally corrosion-resistant. Superficial staining of copper has no serious effect in most applications.

Cadmium and Zinc—White to brown to black mottling. From a maintenance standpoint, the important thing to remember is that, when cadmium and zinc plate show mottling and isolated voids or cracks in the coating, the plating is still performing its protective function.

Nickel and Chromium—Corrosion-resistant. Preservative oils and compounds should be used for supplementary protection.

Noble Metals (gold, platinum)—Tarnish. No attempt should be made to remove in the field.

Common Types of Corrosion

Each type of corrosion must be identified, since each type requires various techniques in removal and arrestment.

Surface—Results from direct reaction of a metal surface with oxygen, and is accelerated by moisture, or by corrosive particles bearing on an exposed surface. All surface corrosion results in general etching of the exposed areas. Best prevention is accomplished by keeping the surface clean and maintaining good protective coatings.

Pitting—A special kind of galvanic reaction, which results from partial protection of an exposed area. Isolated areas become anodic to the rest of the surface. Corrosion products formed accentuate the anodic characteristics in the pit area, and deep penetrating attack develops rather than a general surface attack.

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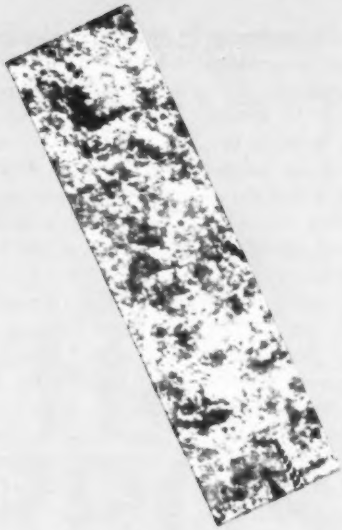
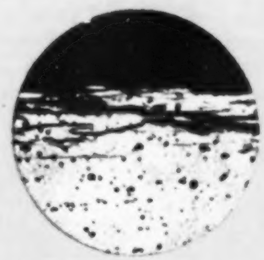
Pitting

Notice that the pits work across the grains, into the metal. Magnified 75 times.

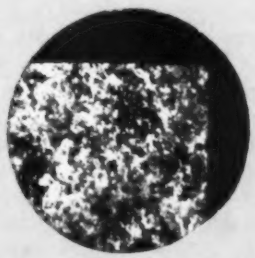
This is the surface of the same piece of metal. Magnified 3 times.



Intergranular



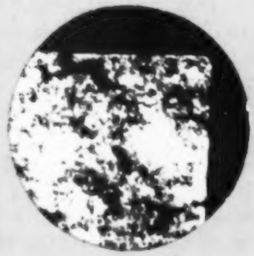
Magnified cross-section. Dark areas show how corrosion works along the grain boundaries.



Surface view of the same piece of metal.

Exfoliation

Cross-section shows exfoliation (caused by intergranular corrosion) has an immediate effect on paint film.



Surface view of same section. An exfoliated surface feels rough.

Keep the surface clean, maintain good protective coatings and maintain drain holes open to prevent entrapment of water and corrosive particles.

Galvanic—Most corrosion is galvanic in nature and involves an exchange of electrons between two points or areas, with the destruction of an anodic area. When galvanic corrosion occurs, either from faulty design or from maintenance errors, the most easily oxidized surface becomes the cathode of the galvanic cell and is protected. Galvanic corrosion may be identified by eating away of metal edges, blistering of paint, and blistering of the metal. The most common areas affected are: stress plates, wing blankets, around steel fasteners and anywhere dissimilar metals are in contact or any two points of metal are in contact with an electrolyte.

Galvanic corrosion is the most detrimental and difficult to arrest of the various types of corrosion. Preventive maintenance requires effective and frequent cleaning. Continuing inspections are necessary and corrosion must be inhibited immediately after detection by highly skilled and trained personnel. Maintain good protective coatings, insulate between dissimilar metals, use effective lubrication and supplementary protective coatings.

Fretting—caused by two surfaces in contact with each other and allowed to move. This continuous motion of the two surfaces causes the metal to be worn away and this residue acts as an abrasive combined with corrosive particles causing further attack. Preventive maintenance consists of lubrication, use of chafing material and proper torquing of the components.

Stress—Stress corrosion is the combined effect of static stresses applied to a surface over a period of time under corrosive environments. Distorted and stressed metals tend to become anodic when in contact with stress-free material, and the galvanic attack occurs along the lines of stress, which in turn results in rapid failure of the part. Preventive maintenance requires frequent cleaning, lubrication, good protective coatings, proper torquing, and use of supplementary protective coatings.

Crevice or Concentration Cell—A form of pitting attack which results from either the differences in the dissolved oxygen or charged metal particles in an entrapped electrolyte. Preventive maintenance will require cleaning, open drain holes, and sealing of crevices and seams that trap electrolytes.

Intergranular—Results from a lack of uniformity in the alloy structure. Corrosion products form which follow the grain boundaries of the metal alloy, causing separation and serious structural weakening. In most cases intergranular corrosion is not detectable by the human eye, until exfoliation or serious failure occurs. Squadron personnel should request P & E inspection from the nearest NARF activity when intergranular corrosion is evident or suspected.

Corrosion Prone Areas

Since naval aircraft are continually exposed to or operating in marine environments both ashore and afloat, specific finishes must be used to prevent or retard corrosion. Paint coatings, chemical films, preservation compounds, plating, and other finishes applied for this protection can be damaged or deteriorated during service operations. Areas that have a tendency for loss of protective coatings are distinguished as corrosion-prone areas. Operators should consult the applicable Maintenance Instruction Manual for their particular weapon system for these areas.

Aircraft Cleaning and Cleaners

Cleaning means the removal of salt, dirt, dust, exhaust residues, fluid spillage, displaced grease and oil films, and other foreign matter from the external surfaces of the aircraft and installed equipment by washing, rinsing and wiping dry, or by wiping down with prescribed compounds or solutions. Cleaning includes removal of soils from surfaces of equipment and parts in the cockpit and nose radome compartments. Proper cleaning is the basic factor in corrosion control. It eliminates the materials that cause corrosion which may exist. Proper cleaning means cleaning with approved methods, equipment and materials as frequently as required to maintain the surface free of corrosion potential.

The Naval Air Engineering Center, Aeronautical Materials Laboratory, lists approved Aircraft Cleaners as follows: Turco 5254, Clarco AQS, B & B 2020 Plus, Brulin 715N, Wyandotte 5397, DuBois C1575-A and Pennsalt 738.

The practice of using cleaners that do not meet specifications outlined under Mil-C-0022543C (WP), should be discontinued immediately, for they may be inadequate and could induce corrosion. Corrosion controllers should make maximum use of technical publications such as; NW-1A-509, Corrosion control for aircraft, NW-1A-506, Aircraft Maintenance cleaning Handbook, NW-15-01-500 Handbook for Aircraft Preservation, NW-15-02-500, Preservation of Aircraft Engines and applicable Maintenance Instruction Manuals for their weapons systems. In addition corrosion control training courses such as those offered by NAMTraDet, and the O & R 801 series should be most helpful.

In conclusion, corrosion cannot be eliminated but can be reduced to the point where it can be controlled.

Inspection and timely removal of affected components prevents failures due to

HOT CORROSION

by
LCDR James G. Hayes
Senior Engineer, Turboprop
Engines, NavAirSysCom

During the early 1960s, aircraft engine manufacturers introduced a series of new super alloys to turbine applications in order to keep pace with the requirement for increased turbine inlet temperatures. These super alloys were ideally suited for turbine blade applications where components are exposed to a higher level of thermally and mechanically induced stresses. Unfortunately though, the new alloys, when exposed to marine environment, were susceptible to a form of accelerated corrosion.

The first cases of this accelerated corrosion were noted on gas turbine installations in marine vehicles. Evidence of the corrosion followed shortly in aircraft gas turbine applications. The extent and seriousness of the corrosion was underestimated when first observed, and widespread use had been made of the new alloys before any concentrated effort was made to understand and counter the problem.

Initially, the corrosion was labeled "black plague" or "black rot" by the British because of its black scaly appearance. Later, the term "sulfidation" was applied to better describe the corrosion in the sulfides that were identified in the affected area. Recently, the term "hot corrosion" has been the accepted term since it better describes the mechanism of the attack.

By experiment, four factors have been determined to be critical in the hot corrosion process. These are:

1. the super alloy composition,
2. the fuel's sulfur content,
3. the presence and concentration of sea salts, and
4. turbine operating conditions.

Because of their interdependence, no single statement can be made about the relative effect of each of these factors; however, general observations have been noted as follows:

Super alloys attacked by hot corrosion are either cobalt or nickel based with low equivalent chromium content. Equivalent chromium content is defined as the net effect of chromium with small percentages of titanium, aluminum and columbium elements acting as corrosion resistant agents. The equivalent chromium content of super alloys is necessarily low to permit the use of a high percentage of elements which gives the metal its superior heat resistant properties.

The sulfur content of the fuel was once considered to be the main contributor to the corrosion process because of metallic sulfides associated with chromium depletion at the surface of the affected metal. Testing has proven that this is not the case. Reducing the

sulfur content of the fuel below specification has no significant effect in decreasing the rate of attack. In some instances, under a sea salt environment, the addition of sulfur to the fuel actually reduces the level of hot corrosion.

The presence and concentration of sea salt in the atmosphere is the principle cause of hot corrosion. The sea salt provides the source of the sulfur and chlorides which are the corrodants in the hot corrosion process. In the absence of a sea salt environment, super alloys in turbine applications have a very good corrosion resistance. The resistance breaks down as the sea salt concentration increases.

Turbine operating conditions, to which turbine components are exposed, are the gas velocities, temperatures, and pressures. These are important factors in the corrosion process. The change of rate of hot corrosion attack is not directly related to changes in temperature, that is, increased temperature does not necessarily increase the rate of attack. In a sea salt environment, hot corrosion starts at a metallic surface temperature as low as 1400° F (760°C). At approximately 1750°F (955°C), a major portion of the hot corrosion deposits are washed away since this temperature corresponds to their melting point. Above 1750° F (955°C), the severity of the attack increases with temperature and can be attributed to a combination of the hot corrosion and accelerated oxidation.

Although the mechanics of hot corrosion are complex, it can best be defined as a process which takes place in two steps:

1. The protective oxides, mainly those of chromium, normally found on the surface of the base alloy, are broken down by the sea salt components, particularly the chlorides.

2. The exposed base metal then reacts with the sulfur forming chromium and nickel sulfides. These sulfides deplete the surface composition of the alloy of chromium and accelerated corrosion follows.

Hot corrosion is first evidenced by a roughened surface. As the attack progresses, the surface becomes scaly and eventually splitting occurs, with loss of metal. See Figs. (1) and (2). In the scaly stage, the affected area is composed of sulfides. These sulfides are black in color and the area exhibits magnetic properties.

Signs of hot corrosion are usually first evident on the leading edges or concave surfaces of turbine component airfoils (Fig 3). The attack may progress

Fig. 1 A turbine blade with leading edge splitting. (Allison 501-D13 first stage turbine blade)

Fig. 2 A turbine nozzle with airfoil leading edge splitting from hot corrosion. (T53-L-11, 318 hours)

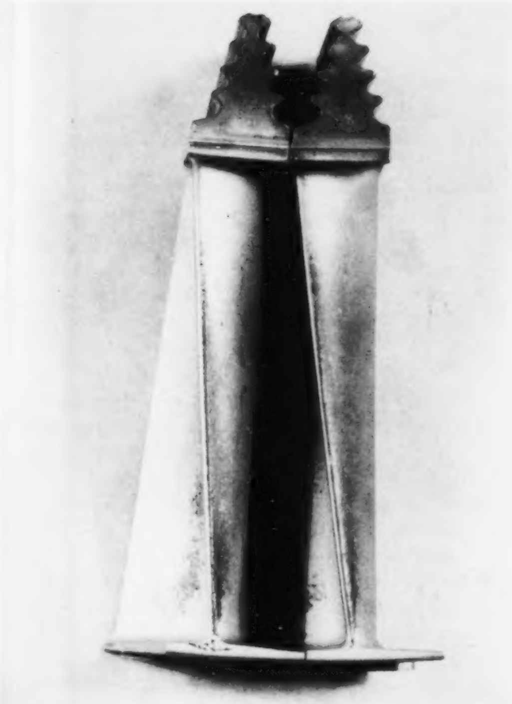


Fig. 3 Attack on leading edge of J52 first stage blade.

to the turbine gases. In advanced cases, even the portion of turbine blades retained within the turbine wheel become affected.

Mechanical failures of turbines from hot corrosion are rare because the attack advances over relatively large areas. Cracks which occur are normally confined within the scaly area. In most cases, *the first evidence of the scaly stage is the proper time to remove the component from service.*

Visual inspection, not loss in performance indication, is the *only positive method* for determining the extent of the hot corrosion attack. Performance loss usually occurs only after the corrosion has reached an advanced stage. Some turbines have actually been found close to complete failure with no signs of power loss. (See Figure 4.)

Before hot corrosion can be eliminated from turbine components, new alloys must be found to replace the current super alloys. It is highly improbable that the other corrosion supporting conditions present will be changed. Although gas turbine manufacturers have imposed heavy pressure on the metals industry, progress in developing new alloys has been slow. In the meantime most manufacturers have resorted to protective coatings on turbine components. These coatings have proven beneficial but are effective only as long as they remain intact. Erosion and impact damage limit their effectiveness. Coatings used are, generally, of a heat diffused aluminum base of a thickness of approximately .002 of an inch. There are variances as to composition and method of application depending on the particular engine manufacturer.

There is no preventive maintenance that will prevent or retard the corrosion process before or after it has started. Water and/or chemical washdowns which are beneficial in combating corrosion in the compressor section of a gas turbine engine may increase the chances of hot corrosion by transmitting salt deposits from the compressor section to the turbine. Some work has been done with the additions of compounds to the fuel; however, this approach is new and will require much more development work before it can be considered even practical. Until new alloys are developed, visual inspection with the timely removal of affected components, is the only maintenance that can be done to prevent turbine failures from hot corrosion.

Fig. 4 Advanced hot corrosion on a first stage turbine rotor detected on an inspection. Engine power loss was not reported. (T56-A-10W, 887 hours)

Max Performance and Good Life from ASE Engines

"What can I do to ensure good operating life from my engines . . . ?" Maintenance is in many cases carried out by drivers or line mechanics. Since sometimes even the most simple precautions are overlooked, we must emphasize the importance of correct maintenance and driving procedures.

A ground support vehicle that is driven properly is always operated within the governed speed; a cold engine is never raced; long periods of idling are avoided and the correct gear ratios are used. Above all, hot-rodding is definitely out. Correct maintenance, besides periodic servicing and adjustments by the mechanic involves daily checks by the driver. He must watch oil and water levels, cleanliness, tightness of components, etc.

Why Do Engines Wear Out?

In order to better understand the importance of these precautions, it would be helpful to know the causes of wear in an engine. There are three types of engine wear, and the first is friction. Minute particles of metal are removed by direct friction between moving parts, particularly in the early stages of the life of an engine. Providing that the machine is not overloaded or overheated during this period, the rate of removal of these metal particles settles down in the running-in period and with correct lubrication, is virtually negligible for the rest of the life of the engine.

The second, usually the greatest cause of wear, is corrosion. One of the harmful products of combustion is the formation of acids in the lubricating oil. The harmful effects of these acids are reduced by oils with the correct detergent classification and viscosity. If oil change periods are not adhered to as

recommended, however, the benefits could be reduced by additive depletion. Harm may also be done by oils with greater detergent properties than specified. Engine bearings corrode and exhaust valves may burn because of build-ups on the stem or underhead area.

The third type of wear is the abrasive effect of dust particles drawn into the engine. These particles are picked up by the softer metals and lap the machined surfaces away.

Combinations of these types of wear may be present and their effects may be intensified by long engine idling, or excessive use of the choke control.

Filters

It is a recognized fact that the greatest single cause of short engine life is improper or negligent servicing, particularly of the air filter. The dry type filter on some machines is more than adequate for all general duties providing care is taken in cleaning the element and changing the element at the recommended interval. In extreme dust conditions, daily inspection and sometimes twice daily cleaning may be necessary. In this event, perhaps the economics of a special filter should be investigated. Also, when cleaning a filter, it is advisable to investigate the interior of the hose between the filter and the engine for dust. If dust is found in this area, the filter assembly is suspect. Extreme care should be used in cleaning this type of filter as it is susceptible to damage by careless handling. This includes the sealing faces and the metal components of the housing.

Adherence to the correct change periods is definitely most essential for oil filters. The heavy duty detergent oils currently used hold considerable quantities of carbonaceous and other materials in suspension. This material is partly removed from the oil in the filter and filter chambers in the formation of sludge.

Although many "will-fit" filters available from parts supply houses will filter the oil to the same degree of particle size as original equipment filters, there is often a marked reduction in the sludge carrying capacity of such filters. This means that the filter blocks sooner and the by-pass valve permits unfiltered oil to flow through to the bearings. The use of correct filters and changing at recommended intervals will add many hours to the life of an engine.

One item often overlooked in engine servicing is the cleanliness of the engine breather. Sludging of this breather will occur over long periods and if not cleaned, the consequent blocking will cause high crankcase pressures. This will cause high oil consumption and oil ring blocking through excess quantities of oil being burned in the ring grooves, and also failure of crankcase seals. It is also important that engines be maintained in correct mechanical condition. Nonstandard settings of ignition, tappet clearance, carburetor or engine temperature controls will generally contribute to shortened engine life. This is particularly true of any condition which will cause the engine to overheat. Overheating may cause excessive oil temperature with consequent deterioration of the con rod bearings.

It is essential that conditions of poor operation or maintenance be recognized and corrected so that a replacement engine will not in turn suffer short life. Mechanics should therefore note air cleaner and air inlet hose conditions, breather tube condition and wherever possible, obtain a sample of the crankcase oil in a clean container. The used oil and oil filter element can be useful in determining the cause of the short life.

A lot can be learned from examination of the components in the engine stripping process. When short cylinder life is evident, but the crankshaft and bearing condition is good, the air cleaner or air intake is suspect. When cylinder life is reasonable, but crankshaft and bearing life is poor, it is an indication that the crankcase oil has been contaminated by dirt or other foreign matter. In the case of short cylinder life, examination of the intake valve and seat can give some idea as to whether the filter had been malfunctioning for some time or that dust had been introduced over a very short period. A long term filter failure would cause deterioration of the inlet valve and seat as well as the cylinder bore. Where this deterioration is absent, it is reasonably safe to assume that the cylinder deterioration was rapid.

The top land of the piston also tells a story. Scoring or grooving of the top land is a pointer to poor air filter maintenance.

The interior of an engine which has been run on the correct lubricants will be free of the sludge or thick deposit which occurs with straight mineral oil. Heavy sludge is usually associated with stuck piston rings and blocked oil ways. The latter can lead to bearing failure. Inspection of the bearings can provide further information. Impregnation of the bearing material with foreign matter, corroded bearings, "pounded" bearings, all give clues to the operation of the engine and can be good guides to the reason for failure. Where the reason for failure can be identified from a study of engine components, the owner of the machine should be advised so that in his future operations these conditions may be avoided.

—Courtesy Hyster "Serviceman"

LETTERS

Corrosion Fighters

NAS Corpus Christi—Ask any maintenance officer in any Navy squadron what his biggest headaches are and chances are corrosion will be one of the items listed. Webster defines the verb corrode as—"To wear away gradually, as by the action of chemicals; to rust."

In the case of naval aircraft the chemical reaction which causes corrosion is triggered by a very common substance. Its chemical symbol is NaCl which stands for sodium chloride or as it is commonly called "salt." Salt is found in abundance in all the oceans and seas of the world and since most naval aircraft fly in close proximity to these bodies of water, the problem of salt spray is a never ending one.

Consequently, the problem of corrosion control is an every day facet of a squadron's maintenance problem. It is estimated that at the present time, VT-31 is expending about 2400 manhours per month on the problem of corrosion control. This figure represents approximately 5 percent of the total squadron maintenance output.

VT-31 *Stoof* gets anticorrosion treatment.

Lieutenant John Williston, Line Division Officer, recently read about a washdown system for the P-3A aircraft developed at NAS Pax River. This started the wheels turning which developed the wash down system now in operation at VT-31.

Not having the financial resources for an elaborate system he designed a simple but effective system. AMSC B. A. Ruddock procured parts and built the system. All of the parts were obtained from scrap material.

The system consists of a 50' perforated pipe and a 20' perforated pipe located adjacent to and in the center of the longer pipe. This arrangement provides maximum water flow in the center to spray the fuselage of the TS-2A. The system is tapped into the seaplane fresh water washdown line which the squadron formerly used to wash down its P5Ms. More piping is planned for the future to give a wider and more solid wall of water through which the aircraft will be taxied.

The system is simple, but the squadron's maintenance officer believes that it will significantly aid his department in the problem of corrosion control.

LT BOBBY D. MANSFIELD

• For more on Corrosion Control, please turn to page 36.

CO Instruction

Pensacola, Fla.—The excellent article in the January 1967 issue entitled "And the Band Played On" references *BuWeps Instruction 3750.4* of 7 April 1966 as being the Navy's instruction on the subject of carbon monoxide.

This instruction has been cancelled and replaced by *NavAir Instruction 3750.1* of 10 August 1966. Apparently it is not distributed to all Commands and activities in which aviation personnel might be stationed. If this information were disseminated it would make the task of obtaining the reference for the article considerably easier.

CDR C. L. EWING, MC
NAVAL AEROSPACE MEDICAL INSTITUTE

• Thank you for bringing to our attention NavAir Instruction 3750.1 of 10 August 1966. The Safety Center did not hold a copy; perhaps, as you suggest, there was a distribution problem. The changes in the instruction concern test procedures and do not affect the text of the article; the two references to the Navy's instruction on the subject should read NavAir Instruction 3750.1 of 10 August 1966 instead of BuWeps Instruction 3750.4 of 7 April 1966.

APPROACH welcomes letters from its readers. All letters should be signed though names will be withheld on request.
Address: APPROACH Editor, U. S. Naval Aviation Safety Center, NAS Norfolk, Va. 23511. Views expressed are those of the writers and do not imply endorsement by the U. S. Naval Aviation Safety Center.

Care and Repair of Hose Fittings

NARTU Norfolk—I would like to add some information to the excellent article "Care and Repair of Tubing, Hose Fittings," in the March 67 issue.

Intermediate and organization levels of maintenance shall *not* salvage and rescue medium or low-pressure (MS-28740, MS24587, AN773) fittings removed from aircraft. Only new fitting assemblies are to be used to fabricate low and medium pressure rubber hose lines as outlined in Accessories Bulletin 8-62, amendment 1.

Concerning hose assemblies (Mil-H-8795) which are exposed and receive frequent water soaking (landing gear, wingfold areas . . .) These shall be coated with rubber cement Mil-A-5092A, Aer Type II on the outer cover of the hose.

Identify treated hose assemblies by painting the end fitting connections with a half-inch wide international orange stripe around the socket. Accessories Bulletin 16-61 refers.

AMHC A. R. POWELL
QUALITY CONTROL

• Good dope, Chief. Airframes mechanics, please take note.

Mk-3C Carrying Cases

FPO New York—We riggers have often discussed the reasons why the carrying case for the Mk-3C life preserver is not stocked as a separate item.

Oftentimes, we have a perfectly good Mk-3C life preserver which passes the flotation test but the carrying case is soft (as in the case of the earlier models), badly worn, or has begun to tear at one of the seams or grommets, and is not practical to repair. Consequently, we have had to M.A.F. (Maintenance Action Form) an otherwise good Mk-3C because we were unable to order a protective carrying case.

We feel that if the Mk-3C carrying case were stocked as a separate item in the supply system, we riggers not only could improve the appearance of many of our shoddy existing Mk-3Cs but eliminate the costly replacement of our present ones.

PR1 JAMES D. CENSALE
VQ-2

• The Aerospace Crew Equipment Laboratory (ACEL) informed us that a contract has been awarded for the manufacture of 300 Mk-3C carrying cases (FSN RM4220-925-0282-L800). Although exact delivery dates are not available, it is expected that delivery will be made in mid-1967.

Survival Kit in Seat Pan

Atsugi, Japan—In CAPT Roger Ireland's article, "You, Too, Can Be a 97-Pound Heavyweight," which appeared in the January 1967 APPROACH, it was stated that "uncontrolled mass distribution of personal equipment upon the aircrewman's body could shift the center of gravity of the seat-man mass away from the ejection force thrust axis to the extent that spinal injury is increased from the catapult impulse."

Periodic maintenance checks on A-4 seat pans in the WestPac area have revealed that occasionally survival kits are stowed in a hole cut from the foam rubber seat cushion. This, in itself,

Modified A-4 seat pan.

could result in soft tissue injury to the thighs during ejection but combined with an overloaded "Teddy Bear" could prove disastrous to the aircrewman's spine as well as rendering the survival kit unusable.

CAPT N. D. SANBORN, MC
SENIOR FLIGHT SURGEON
LT S. H. LIBIEN, MC
NAS ATSUGI FLIGHT SURGEON
LT M. SAUNDERS, MC
VQ-1 FLIGHT SURGEON
LT A. R. WILLIAMS, JR., MC
VRC-50 FLIGHT SURGEON

• This modification with either the PSK-2 or SEEK-2 kit is unacceptable. The SV-2 vest, of course, is the recommended means of carrying survival kits.

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Our product is safety, our process is motivation and our profit is measured in the preservation of lives and equipment and increased mission readiness.

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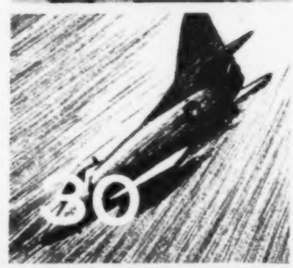

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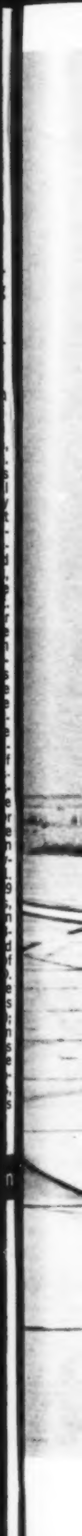
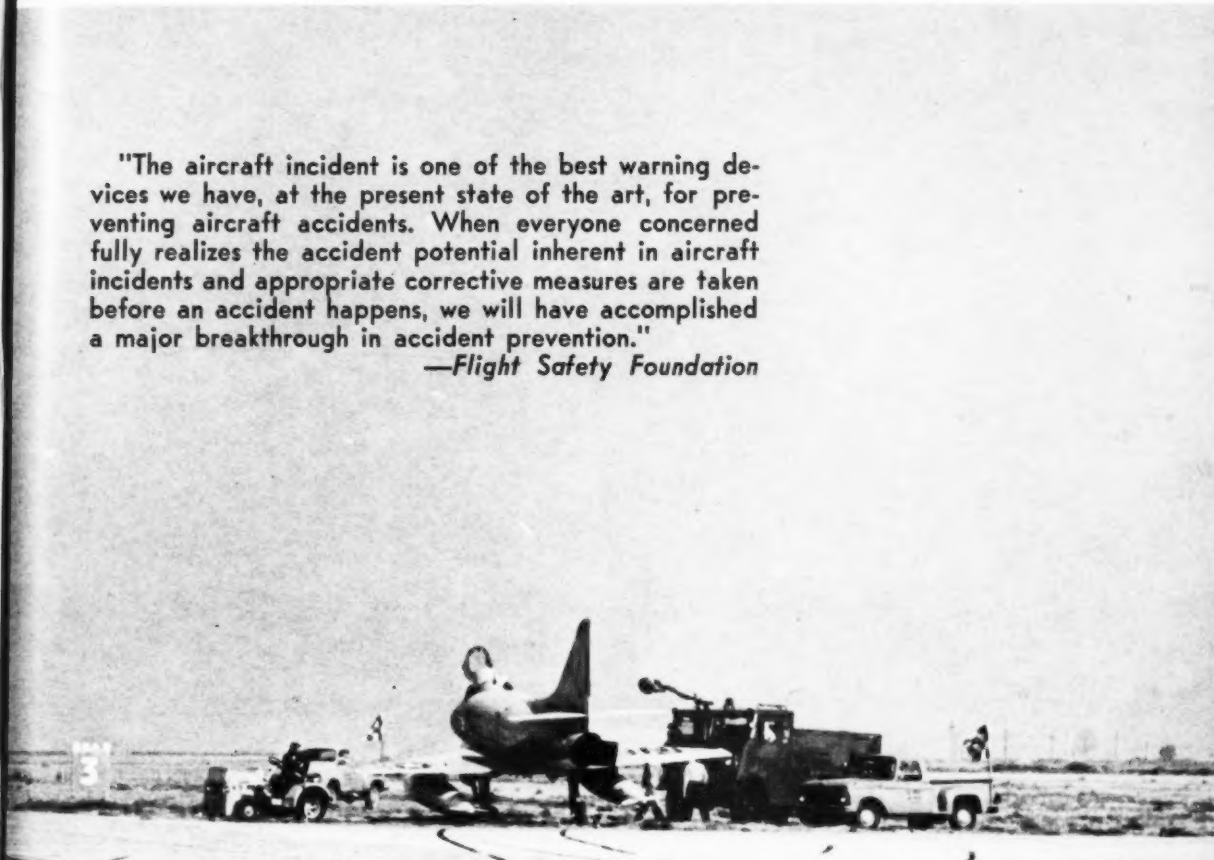


"The aircraft incident is one of the best warning devices we have, at the present state of the art, for preventing aircraft accidents. When everyone concerned fully realizes the accident potential inherent in aircraft incidents and appropriate corrective measures are taken before an accident happens, we will have accomplished a major breakthrough in accident prevention."

—*Flight Safety Foundation*



DON'T BE, WHEN IT'S NOT

Contributed by VA-106